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Study of Florida's Windstorm Mitigation Credits

Assessing the Impact on the Florida Insurance Market

A Report prepared for Florida Legislature

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FINAL REPORT

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Study of Florida's Windstorm Mitigation Credits.

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EXECUTIVE SUMMARY

Introduction

Risk Management Solutions (RMS) has conducted a comprehensive study of the implementation of windstorm mitigation credits (WMCs) in the state of Florida and their impact on the insurance industry. The analyses in this report complement other studies on improving the management and mitigation of hurricane risk in Florida, including the Windstorm Mitigation Discounts Report by the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM)[1] and a concurrent study commissioned by Florida's Department of Financial Services (DFS) to evaluate the system for state-wide inspections of residential construction[2].

Windstorm mitigation credits are reductions on wind insurance premiums for residential policyholders, based on the strength of a home to withstand wind damage. They are intended to promote stronger construction practices across the state of Florida, providing credits for such construction features as roof strength, roof covering performance, and opening protection. First addressed by the Florida legislature in 2000, the WMCs were based on a hurricane modeling study in 2002, and were promulgated to insurance companies as Office of Insurance Regulation (OIR) recommendations in 2003. In 2007, these recommended credits were revised by the OIR and adopted by insurance companies providing residential wind coverage in Florida.

The 2002 hurricane modeling study, completed by Applied Research Associates (ARA), Inc., created a series of relativity factors that classified residential buildings by their resistance to wind damage, based on such attributes as the size of the nails fastening the wood deck to the rafters, the presence of hurricane shutters, and the shape of the roof (e.g., gable or hip). From these relativity factors, the OIR developed a normalized table of windstorm mitigation credits, where the "weakest" building[3] that represents 1% of the residential building stock, receives no premium credits and the remainder of the building stock qualifies for various sizes of credits, depending on the home's attributes. Homeowners can qualify for a WMC by completing an inspection on their property and submitting the results to their insurer. Insurers then utilize their premium base rate tables in conjunction with the WMC table to determine the appropriate premium.

Problem Statement

Since 2007, reported premiums for residential insurance coverage have decreased substantially. For example, the state-wide average residential insurance premium, reported in the OIR's Quarterly Supplemental Reporting system (QUASR), has dropped by 20%, with at least one company reporting a reduction of over 50%. While premium reductions are welcome by Florida residents, there is concern about the financial strength of insurers providing coverage. For example, in the second quarter of 2009, 109 of the 210 companies in Florida reported underwriting losses - without suffering any hurricane losses that prior year. While premium reductions and underwriting losses may not necessarily be due to the implementation of WMCs, a study of the impact of the credits on the insurance industry was initiated to determine if they play a role.

Methodology

RMS has designed a set of analyses to objectively determine whether the current implementation of wind mitigation credits is a significant contributing factor to the reported decline in Florida insurance premium income. The study consists of the following four elements:

[1] http://www.sbafla.com/methodology/pdf/2010/wmc/Mitigation Discount Report 2-1-10.pdf
[2] Hurricane Mitigation Inspection System Study" by The Florida State University College of Business: DFS RFP 09/10-10
[3] Features that define the weakest building are gable roofs, with non FBC shingle roof cover, roof deck with 6d nails, toenail roof truss anchors, and no opening protection.

1. Evaluating the loss-cost relativity matrix that was the basis for the current WMC table used in establishing premium rates;
2. Assessing the implementation of the WMCs, including a review of the process and assumptions in their development and the use of WMCs in practice by Florida insurance companies;
3. Measuring the impact of WMCs on typical insurance companies in Florida, including changes in premium rates; and
4. Examining the incentives given to Florida homeowners to harden their homes, given the existing scope of WMCs and alternative schemes for credit implementation.

In order to quantify the impact of WMCs on Florida insurance companies, RMS developed a state-wide insurance portfolio as it existed before the introduction of WMCs, measuring the change in insurance revenue and expenses[4] as homeowners voluntarily inspect and provide information about their homes' wind resistance to their insurance providers. A unique feature of the RMS analysis is the development of the state-wide portfolio through time, capturing the impacts of the WMCs on the insurance industry as structures are inspected and reported. Thus, impacts of the current WMC system on insurance industry premiums at various points in time are calculated, compared to the reported decrease in premiums, and evaluated against both the current WMC system and alternative schemes for implementation.

Key Findings

Hardening (i.e., increasing the wind resistance) of homes continues to be an effective way to reduce hurricane risk in Florida. If every home across the state were hardened to a construction standard that exceeded the most current building code, RMS estimates that insured average losses per year would reduce by over 70%[5]. However, the cost and time needed to retrofit or rebuild the 4.9 million homes in Florida to this standard is impractical. Therefore, risk reduction strategies must focus on realistic programs and policies that homeowners, policy makers, and insurers can reasonably pursue, such as the WMC system. When appropriately applied, WMCs provide incentives to retrofit existing homes and encourage better wind resistance in new construction, while not adversely impacting the financial strength of insurance companies.

However, at present, the WMCs are not operating as intended, and according to the RMS analysis, are a significant contributing factor to the reported premium degradation. The analysis reveals that implementation of the WMC system program has not significantly hardened the building stock. Of the estimated 20% of homeowners who have performed inspections, only 2% of the population has actually hardened their homes; the majority of wind inspections have resulted in a reclassification of the risk (i.e., a better understanding of the home's resistance to wind damage). RMS has concluded that this reclassification of risk, in conjunction with the WMC implementation, has resulted in a 20% drop in state-wide insurance premiums. Moreover, wide geographic variations are possible, with drops in premiums of 40% or more in certain South Florida counties.

These calculations confirm that the current WMC system is a plausible contributor to the reported 20% drop in premium over the past few years, with little or no change to the inherent risk or associated fixed costs. It should be noted, however, that additional factors – not considered in this analysis – may have contributed to underwriting losses. These factors include: the inherent variability of losses, continued claims payments from previous hurricanes (e.g., Hurricane Wilma), declines in investment asset values due to the current financial market conditions, policyholder renewal and home purchase decisions, coverage adjustments, and non-catastrophic or non-hurricane losses.

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[4] In this study, revenue is derived from collected insurance premiums. Expenses include fixed costs (e.g., costs paid for administration and overhead), variable costs (e.g., costs paid for expected losses), and reinsurance costs (e.g., the premium cost of purchasing reinsurance to limit a primary insurer's loss in the case of a large event).
[5] See RMS Special Report on *Analyzing the Effects of the My Safe Florida Home Program on Florida Insurance Risk*. http://www.rms.com/Publications/RMS_MSFH_Report_May_2009.pdf

Reclassification versus Hardening of Properties at Risk

The WMCs were intended to encourage homeowners to take measures to harden their homes against wind damage. However, homeowners began to provide insurers with details on previously unreported wind rating attributes, for which the WMCs were then applied to the homeowner premium. For example, a property that was originally known to be a one-story wood frame structure built in 1988 is now known to be a one-story wood frame structure built in 1988, with a hip roof, 6d roof deck nails, no hurricane opening protection, and an FBC-equivalent roof cover. Many of these attributes were present before the WMC system was introduced, and when aggregated with other homeowners in the neighborhood, can be considered to be implicitly embedded in the pre-WMC territorial insurance rate. Thus, from an insurance company perspective, the information can be considered a pre-existing condition within the insurer's portfolio and the risk is now re-classified. This does not mean that the individual homeowner should not qualify for the credit associated with those specific attributes – quite the opposite is true; the RMS analysis indicates that building-specific rating is very effective in encouraging building-specific hardening. However, if the amount of premium credit is too large and/or the number of homes that are receiving credits is too large relative to the actual risk reduction, negative impacts on insurance company premiums can result.

Contributing Factors

The impact of the windstorm mitigation credits on the Florida residential insurance market is due to a number of contributing factors, including:

- Use of voluntary inspections to collect property information;
- Statutory language establishing the WMC system;
- The WMC normalization point and requirements for insurance base rate offsets;
- Impacts of the WMC system on reinsurance costs; and
- Modeling of residential property risk for WMC development.

Voluntary Inspections

Property inspections to determine WMCs have been primarily completed through the voluntary participation of homeowners across the state. Inspections have been performed by either private wind inspection firms, or funded through the My Safe Florida Home (MSFH) program, which provided free wind inspections, inspector certification, quality control, re-inspections, and mitigation grants to Florida residents until it expired in June 2009. The MSFH program also included a grant program that was targeted at hardening homes of low-income property owners.

Examination of the data in the MSFH program indicates that properties included in this type of voluntary inspection process (in both the MSFH program and the private inspection market) are more likely to be high-value, already well-mitigated and/or in the highest hazard areas. This bias makes it difficult to determine the degree to which reclassification versus hardening of properties at risk is occurring within a given insurance portfolio. This bias can frustrate efforts by insurance companies to demonstrate a need to raise base insurance rates to rebalance the premium income stream. If inspections were more systematic across the full range of properties, the data would be more useful in rate filings.

The Role of the Statutory Language

In the 2000 statue that enacted the windstorm mitigation credit system (627.0629 F.S.), it states that: "[rate filings for mitigation credits] must include actuarially reasonable discounts, credits, or other rate differentials, or appropriate reductions in deductibles." The language in this statue describes rate differentials in terms of discounts and reductions, with no language describing rate differentials as increases or surcharges. As a result, the WMC system was implemented in the form of credits or reduction in premiums only – with no allowance for increases or surcharges on premiums.

Choice of Normalization Point for Credits

As mentioned earlier, the WMC table was developed by normalizing the credits relative to the "weakest" building (i.e., least resistant to wind damage). At the August 2009 FCHLPM hearings, the OIR testified that this choice was mandated by the language in the 2000 statute. **The WMC table is being used in conjunction with insurance "base rate" tables, which contain premium amounts for the average risk in a territory – not the weakest building. This means that WMCs are applied to an average rate for premium calculations, but the corresponding credit is relative to the weakest building.** Although this sounds inconsistent, theoretically, this misalignment between the WMC table and the base rate tables is irrelevant, **if** an insurer can adapt and adjust base rate tables over time (through its annual filing mechanism), as properties in its book of business are inspected and homeowners apply for credits.

However, in 2007 when the WMC system was implemented, base rate offsets were initially not allowed by Emergency Rule of the OIR. Since then, the rule has been lifted, and filings for base rate offsets may now be made by insurance companies. However, the requirements to support the offset in base rate tables are not easily achievable, as an insurer must demonstrate the degree to which reclassification versus hardening is occurring in its portfolio. In order to demonstrate this, data on a significant portion of the uninspected properties must be gathered, which functionally compels an insurer to inspect 100% of the properties in its book of business. The costs associated with such actions are often prohibitive.

In its current implementation (i.e., normalized to the weakest building), the WMC table allows 99% of the homes in the state to qualify for some level of credit. At present, RMS estimates that, with 20% of the population inspected, average statewide premiums have reduced by 20%. If the WMC system continues in the absence of a base rate offset, the average premium reductions could ultimately reach 35%, which would clearly have an impact on insurance revenues.

The combination of the "weakest" building choice, in conjunction with limiting base rate offsets, has unintended consequences for incentives to harden homes. With major reductions in premiums, there is no added benefit derived from investing in hardening measures. RMS concludes that voluntary hardening will occur in, at most, 4%[6] of the population. However, the analysis also illustrates that if base rate offsets occurred or the normalization point was shifted to an average building, voluntary hardening would occur across 20% of the population over time – a significant improvement over the current estimate of 5%.

Reinsurance Costs

RMS conducted analyses to examine the degree to which WMC data might be reflected in reinsurance costs. Given that the current WMC data stream is more heavily reflective of reclassification versus hardening efforts (i.e., the underlying risk is not changing) and the data stream is only for a small portion of the portfolio and is biased towards wind resistant locations in high hazard areas, the WMC data simply acts to imply a reduction of portfolio risk that may not be valid.

Reinsurers are not likely to incorporate detailed mitigation feature information in their risk assessment until such data is available more widely across insurance portfolios to avoid possible biases associated with this data currently only being available for a limited subset of individual portfolios. Thus, reinsurance rates are unlikely to change until the WMC data are collected on a significant portion of the population. So, while a primary insurer might have diminished premiums due to the WMC system, reinsurance costs can be expected to remain constant, applying further pressure to the primary company balance sheet.

[6] Assuming funding for hardening measures are secured with a home improvement loan with a 5 year amortization period.

Modeling Residential Property Risk

RMS performed an analysis similar to the one developed by ARA in 2002, concluding that the relative loss differences from the RMS model are in general alignment with those developed by the 2002 ARA study. However, the RMS model produces a wider range of losses for the construction characteristics used in the loss cost relativity matrix, indicating a more thorough differentiation of the risk. It should be noted that although there can be some measurable differences between various model results, these differences are not responsible for the insurance premium degradation observed in 2009.

As a method of risk classification, the loss cost relativities, originally developed in the 2002 ARA study, can be improved by including additional risk differentiation factors, such as the number of stories of a structure, the size of the living area, and the roof slope. By incorporating these additional features in the WMC system – with properly aligned base rates – the percentage of homes voluntarily adopting hardening measures can increase to 30% or more by applying the highest rates to the highest risk properties and therefore maximizing the amount of insurance credit benefits available to the homeowner.

Recommendations

Insurance companies need to be able to correct the alignment between the WMC and base rate tables to alleviate the premium erosion caused by the current WMC implementation. Of the specific implementation approaches RMS was retained by DFS to analyze, RMS quantitative analyses indicated that, when looking directly at the alignment of insurance rates and WMCs, the most effective method to address shortcomings of the current implementation of WMCs would be to keep the current WMC scheme intact but to allow insurance companies to raise their base rates in order to achieve the desired incentives for hardening throughout the state. Adjusting base rates across the industry will be more effective at elevating the hardening levels than cutting the magnitude of credits in the existing WMC tables. RMS estimates that appropriate increases in premium base rates will incent 10% of the population to harden their homes in the long term, and possibly up to 20% of the population if one considers additional risk differentiating factors (e.g., number of stories of a structure, the size of the living area, and the roof slope). The justification for changes in base rate tables should remain with the insurance companies and be rigorously reviewed by the regulators. However, clear guidelines from the OIR on specific data requirements to allow base rate changes would allow smooth administration of the process.

The legislature should be promoting, through statutory language, the use of wind rating variables that reflect the widest difference between the highest and lowest risks so that the mitigation incentive signal is fully transparent. In other words, the list of variables currently cited in F.S. 627.0629 (1)(a) should be expanded to include other important differentiation factors like roof shape, number of stories, living area, and roof slope. Language should also be added that allows companies to use both credits and surcharges in their rating method, as appropriate. This will also relieve the apparent statutory requirements that equate WMC variables to credits. The law as it applies now has forced the OIR to interpret the ARA study as a credit-only program rather than a more rational credit/surcharge methodology.

Insurance companies need to be encouraged to incorporate a full set of wind rating variables into pricing formulas for all properties. By allowing the widest possible rate differentials, RMS estimates that more than 30% of the population can be motivated to harden their homes through WMCs. This will require companies to modify existing methods of calculating insurance premiums to include a fuller set of rating variables. Almost all of the FCHLPM-approved models are currently capable of providing valid loss relativities that can be leveraged for these purposes. Insurance companies should certainly be expected to demonstrate that the underlying distribution of features is understood and has been applied appropriately by the insurer.

Data quality is critical to ensure that the industry can measure the degree to which reclassification versus hardening is occurring. To improve the quality of the mitigation data stream, RMS recommends the following changes to ongoing efforts of the Florida Hurricane Catastrophe Fund (FHCF) to collect additional wind rating variables through its yearly data call[7]:

- Reported variables align with the variables currently used in the Uniform Mitigation Verification Inspection (OIR-1802) form and, therefore, the WMC variables;
- Other key rating factors, such as number of stories and square footage, and roof slope, are collected;
- The unknown state of a variable is collected separately (i.e., uninspected), so that the industry can measure the progression of data collection over time. For example, rather than lumping "gable" and "unknown" together, the data call must require companies to identify these separately. This is a key issue that will make it easier to measure the degree to which reclassification versus hardening is occurring within the state.

Reduce the upfront cost of mitigation – either through longer amortization periods for loan repayments or a grant program to encourage mitigation, such as the My Safe Florida Home (MSFH) program. Our analysis has assumed that money for hardening efforts is funded through home improvement loans that must be paid back within 5 years. Under that assumption, we note that approximately 20% can be motivated to harden if the WMC table is revised. If the pay-back period is increased to 30 years, then the hardening level within the building population is estimated to double. In other words, almost 50% of the homeowners will voluntarily undertake hardening measures to take advantage of insurance credits. Alternatively, grants to offset the hardening costs would achieve the same effect.

Limitations

This report has been prepared in accordance with the terms of an agreement between Risk Management Solutions (RMS) and the Department of Financial Services (DFS) of the state of Florida. This report, and the analyses, models and conclusions contained within, are based on publically available data on the insured residential properties at risk in the state of Florida and compiled using the RiskLink® catastrophe risk assessment system. The reliability of the loss estimates presented within this report is largely dependent on the accuracy and quality of data available to RMS.

The results contained herein are representative examples of potential impacts, and should not be interpreted to have meaning outside the context of this report. Simplifying assumptions and selections have been made to facilitate the analysis, although every effort has been made to retain a realistic portrayal of conditions. The results are not applicable to any specific company; rather, they represent a snapshot of the personal residential property insurance market in Florida over the range of time described in the report.

Available premium information was at the county level, which contains details that represent the average or aggregate of risks within that county. Wide variations within each county will exist. Our methodology was guided by the requirements of the Florida OIR's I-File online requirements, as well as related information publicly available via the OIR's I-File system. The indications and assumptions are not actuarial rate indications. Different results could be obtained from reasonable alternative starting points, assumptions, data, and/or methodologies.

Analysis of the mitigation credits levels should be interpreted as described within and should not be used without additional analysis, which may include substantial adjustments, for any other purpose.

It should be emphasized that this analysis does not assess the absolute adequacy of insurance rates; rather, the analysis assesses the adequacy of rates in the context of the intent versus implementation of the WMCs. This report focuses on asymmetrical/biased data collection, as explained in the report. All analyses, data, assumptions and methodologies, except where specifically noted otherwise, have been completed based on this condition.

[7] Each authorized insurance company writing Covered Policies in the state of Florida must submit its total covered property exposure each year; this information is collected by Paragon Strategic Solutions Inc. and is available at http://fhcf.paragonbenfield.com/.

SECTION 1: INTRODUCTION

The people and property of Florida are extremely susceptible to hurricane risk. The more hurricane-hardened the infrastructure and buildings, the better able the state will be to withstand the damage a hurricane can inflict on Florida's population and building stock. For the past 10 years, Florida has worked to promote hardening efforts within the state using the insurance pricing mechanism known as Windstorm Mitigation Credits (WMCs), which provides insurance pricing discounts for homes with hurricane-hardened features.

However, in October 2009, the Office of Insurance Regulations (OIR) reported that 102 of 215 insurance companies in Florida reported underwriting losses in the second quarter of 2009 [57]—*without* the occurrence of a hurricane. The occurrence of underwriting losses in the absence of a hurricane event presents a major concern to insurance companies, regulatory agencies, and the citizens of the state, about the ability of Florida's insurance market to pay claims following a hurricane – which could leave many householders unprotected. Many stakeholders are concerned that the Windstorm Mitigation Credits are partially responsible, at least, for the current situation, and could be a driving factor. In reaction, many insurance companies are instigating windstorm mitigation credit re-inspection programs to verify the validity of granted mitigation credits. This report has been designed to respond to DFS RFP 09/10-14 requirements by objectively evaluating the degree to which the WMCs have negatively impacted the insurance industry, the incentive levels for residential policyholders to adopt mitigation features, and an analysis of the impacts if changes were made to the current system. Although RMS has used its proprietary catastrophe model, RiskLink®, in these analyses, for contrast, the report has been prepared as an objective evaluation of the WMC implementation process, and not a comparison for competitive reasons.

FCHLPM Hearings on Windstorm Mitigation Credits

In the 2009 legislative session, the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) was directed in F.S. Sections 627.0628(4) to hold public meetings regarding the development, application, and implementation of windstorm mitigation credits. The FCHLPM held an extensive series of public hearings and working sessions beginning in the fall of 2009, which culminated in a report delivered to the legislature on Feb 1, 2010, entitled *Windstorm Mitigation Discounts Report* [25]. The report summarizes the public testimony, as well as the opinions and recommendations of the commission members who examined this issue.

Testimony in these hearings came from many parties, including the OIR, catastrophe modeling firms, inspection firms, insurance agents, insurance companies, trade groups, citizen action groups, and practicing actuaries. During the hearings, testimony was given on:

- The legislative initiatives related to windstorm mitigation credits and the application of the WMCs to insurance companies in their calculation of premiums;
- The Applied Research Associates (ARA) reports that are used as the basis for the currently recommended mitigation credits;
- The process used by the Florida OIR to implement the loss relativities from the ARA reports and the relationship with insurance companies' base rates;
- Timing issues that affect insurance companies with respect to the collection of the more detailed structural attributes through private inspectors and/or through the My Safe Florida Home (MSFH) program [117];
- Data quality issues affecting various insurance companies; and
- Barriers to reflecting mitigation credits in the risk transfer between primary insurance companies and the reinsurance market.

The FCHLPM report describes four broad sets of recommendations under the categories of:

- Rating and the Determination of Windstorm Mitigation Discounts
- The Residential Structure Inspection Process
- Data Quality
- Hurricane Computer Modeling

Broadly speaking, the first set of recommendations focuses on who reviews and develops the windstorm mitigation credits (WMCs), and how the WMC system should be implemented within insurance rating plans. The second category of recommendations is designed to reduce the potential for erroneous or even fraudulent data collection, through the implementation of a statewide inspection system - similar to the My Safe Florida Home program run by the state between 2006 and 2008. The third category, related to data quality, calls for the inspection of all residential structures in the state. Lastly, the fourth set of recommendations in the FCHLPM report addresses the need for consistency in the use of modeling for WMC and loss cost determination.

The next step following the Windstorm Mitigation Discounts Report, which focused on public testimony, is to provide an analytical approach to quantifying the impact of the existing WMC structure on premium income to further verify the conclusions and substantiate the recommendations. The Windstorm Mitigation Discounts report included a section that described “indications” of problems associated with the WMC system, and clearly stated “Data that directly address the impact of windstorm mitigation credits on insurer performance are not currently readily available.” RMS has therefore undertaken a study, commissioned by the Department of Financial Services, which analyzes the impact of the current WMCs on the Florida residential building stock.

This report presents analyses that complement some of the issues and recommendations contained in the FCHLPM report. Specifically, this project focuses on quantifying the impact that WMCs have had on insurance companies over the last few years. Examination of the issues related to the inspection process and data quality are outside the scope of this study. Note that these two issues are being studied by the Florida Department of Financial Services under a different contract (DCS RFP 09/10-10).

Theory behind Windstorm Mitigation Credits

Figure 1 illustrates how rebuilding all of the single-family dwellings in Florida to a more stringent building construction standard, such as the Institute for Business and Home Safety’s (IBHS) Fortified…for safer living® program (http://www.ibhs.org), could dramatically reduce risk. In this case, the 100-year loss is reduced by 77%—a significant reduction in claims liability. However, as rebuilding the 4.9 million homes in the state of Florida is not a feasible scenario, one can view this result as the extreme bound and recognize its usefulness as a reference rather than as an achievable goal. In practical terms, the challenge is to determine the minimum amount of investment in retrofitting that could significantly reduce the 100-year loss level.

Experience from the 2004–2005 storm seasons, along with calibrated catastrophe models using sound engineering principles, like the RMS® U.S. Hurricane Model, demonstrate that mitigation features such as hardened roofing materials, strengthened decks, and opening protection are effective in significantly reducing losses.

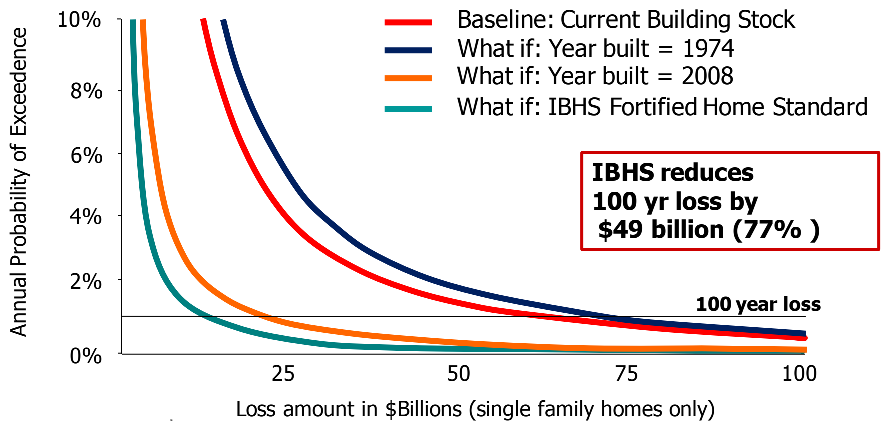


Figure 1: Exceedance probability curve for single-family dwellings in Florida, as modeled by the RMS® U.S. Hurricane Model

The Florida legislature recognized the need to promote the hardening of homes, and has sought to use the insurance system as a way to promote the adoption of mitigation features, as reported in the *Windstorm Mitigation Discounts Report*, February 1, 2010. The proposed process for the mitigation credit program is illustrated in Figure 2. This figure depicts a system in which individual homeowners would evaluate the benefit of hardening their homes by comparing the cost of retrofitting the home with the potential savings in insurance premiums. If the savings per year exceed the cost per year, the homeowner would be expected to proceed with the voluntary hardening of the structure. The number of homeowners who actually do this depends on a number of factors, including their view of risk. Using information on the characteristics of residential properties across the state, this report estimates the proportion of the population that may voluntarily harden their homes, considering a range of scenarios.

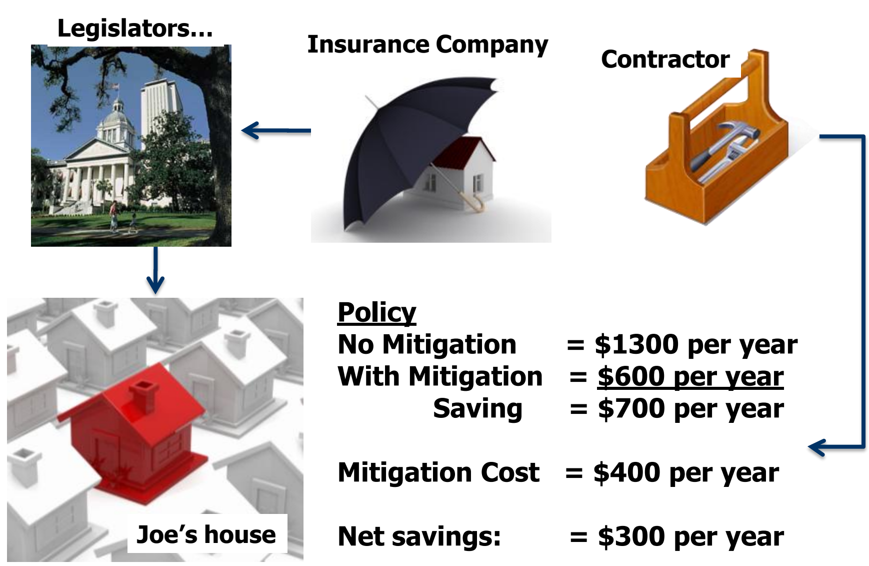


Figure 2: Theoretical process through which Windstorm Mitigation Credits promote retrofit activities on homes

Evidence of a Problem

As early as 2008, insurers were reporting that windstorm mitigation credits were significantly reducing insurers' premium revenues. Reports from insurers suggest that the premium reductions related to WMCs have a negative impact on insurers' financial standing:

- In 2008, Citizens Property Insurance Corporation began reporting that windstorm mitigation credits were going to reduce their premium income significantly, during a period in which their rates were "frozen." As of 2010, windstorm mitigation credits currently reduce Citizens' annual premium base by almost $800 million.
- State Farm Florida alluded to the impact of windstorm mitigation credits as one of the reasons it filed plans to withdraw from writing property insurance in the state of Florida.
- In early 2009, independent financial rating organizations, A.M. Best and Demotech, downgraded or withdrew the financial strength ratings of a number of Florida property insurers.
- On October 6, 2009, in testimony to the Florida Senate Banking and Insurance Committee, Florida Insurance Commissioner Kevin McCarty indicated that windstorm mitigation credits were among a list of factors adversely impacting insurer financial performance in Florida.

To date, there is no direct evidence connecting the WMCs to negative financial results, as outlined in the *Windstorm Mitigation Discounts* report. There are a number of complex and interrelated factors that can affect an insurer's financial health, including:

1. the loss of revenue associated with providing increased windstorm mitigation credits [e.g., Citizens Property Insurance Corporation provided statistics that the average mitigation credit for its wind-only policies increased by 100.9% between Q4 2007 and Q3 2009 (rising from an average of $763 per policy to $1,553 per policy)];
2. the losses in investment asset values due to recent financial market conditions;
3. continued loss development from hurricane claims, particularly Hurricane Wilma;
4. increased non-catastrophe losses in recent years; and
5. the replacement of reinsurance coverage offered by the Florida Hurricane Catastrophe Fund with more costly private reinsurance.

History of Windstorm Mitigation Credits in Florida

The FCHLPM windstorm mitigation committee heard testimony from several parties [67], including the OIR, regarding the history of the legislative statutes and regulatory memorandum and rules relating to mitigation credits. The *Windstorm Mitigation Discounts Report* contains a comprehensive timeline of the key points in this history.

There are three key time periods in this history that can be used to assess the impact of the WMCs on insurance premiums: pre-2003, 2003–2007, and post-2007. Until 2003, most insurance companies offered small discounts for having shutters installed on a home. In 2003, a more detailed credit system was introduced that relied on the homeowner to voluntarily declare the presence of mitigation features. In 2007, this credit system was changed once more to functionally increase the amount of the credits associated with these mitigation features.

February 28, 2003 – Insurers required to submit rate filings that include windstorm mitigation credits

On February 28, 2003, new requirements were introduced requiring insurers to expand the sophistication of mitigation rating factors from the existing "shutter" discounts to include other factors related to strengthening items like the roof deck and roof covering. The relevant wording of the statute in section (1) includes the following:

> "A rate filing for residential property insurance must include actuarially reasonable discounts, credits, or other rate differentials, or appropriate reductions in deductibles, for properties on which fixtures or construction techniques demonstrated to reduce the amount of loss in a windstorm have been installed or implemented. The fixtures or construction techniques shall include, but not be limited to, fixtures or

> construction techniques which enhance roof strength, roof covering performance, roof-to-wall strength, wall-to-floor-to-foundation strength, opening protection, and window, door, and skylight strength."

The statute represents the culmination of activity that began in the 2000 statutes, in which legislators introduced new provisions to the Florida Statute pertaining to residential property insurance rate filings (s. 627.0629 F.S.).

The law only contains language related to lowering insurance costs (e.g., "credits" or "discounts"). In addition, the list of construction techniques and fixtures does not explicitly include roof shape. Although not explicitly stated, it is reasonable to infer that underlying this language is an assumption that these mitigation fixtures are not common in the general population, and adoption can be actively promoted though the offering of credits.

Following the 2000 statute, two key developments took place before the first version of the WMC system was implemented in insurance company rate plans in 2003. First, in 2002, the Department of Community Affairs commissioned a study conducted by an hurricane catastrophe modeling firm, Applied Research Associates (ARA), which resulted in a set of hurricane loss relativity factors—a measure of property loss, based on the characteristics of a building. In the modeling study, the loss factors were normalized to the 'typical' house in Florida (e.g., a certain roof shape, opening protection, etc.). Second, the OIR suggested a set of WMC tables based on the ARA study in a series of memorandums (June 6, 2002 [110] and Jan 23, 2003 [99]). The OIR recommended a set of WMC tables that were normalized to the 'weakest' building in the 2002 ARA study [3] (i.e., the type of building most susceptible to wind damage), and compressed the loss relativity factors by 50%.[8]

March 1, 2007 – Insurers required to incorporate fully indicated WMCs into rating plans

In late 2006, the Financial Services Commission changed the credit system by adopting revisions to rule 69O-170.017, F.A.C. This rule removed the 50% compression of the WMCs in the OIR memorandum of 2003 and required all insurance companies to revise their WMC tables. The normalization point remained the weakest building in table, thereby providing discounts or credits on insurance premiums to every other type of building in the state. The rule indicated that these factors could not be modified unless alternative detailed studies were produced, similar to the 2002 ARA study. Also, no offset of rates for lost premium revenue was allowed in the implementation of the new fully-indicated WMC factors.

Because of concerns about the original study, the OIR asked for bids for an updated relativity study, which was awarded to ARA [2]. This new report introduced additional rating variables, some related to risk differentiation and some related to mitigation. However, to date, the results of this study have not been adopted or promulgated in other recommendations by the OIR, as it felt the results were similar to the original study.

Rating Variables and Data Fidelity

Insurance represents a method of risk-sharing amongst all the participating policyholders, offering protection from unpredictable financial losses that could negatively impact any one single policyholder. An insurance rate is a function of the policyholder's risk and is often quantified in terms of the sum of the total average annual (expected) loss divided by the number of policyholders. Because each policyholder does not have an equal probability of sustaining a loss, a way to differentiate the price between different policyholders must be found. Insurance plans provide differentials between different classes of policyholders and charge those that tend to have higher risk more than those that tend to have lower risk. The choice of what variables to use is very important as these variables should be tied to something that is related to the underlying risk either directly or as an appropriate proxy for other variables[9]. For example, year built is often used

[8] The details of the implementation process are discussed in more detail in Section 3.
[9] A key challenge for catastrophe risk, however, is the allocation of risk among stakeholders in a manner similar to what is done for more frequent, non-extreme events.

as a proxy for construction quality as the age of the building indicates a specific building code and level of enforcement for a specific area.

The choice of the proper set of variables largely involves balancing the accuracy with which a risk can be classified against the practicality of collecting and classifying the risk with the given information. In theory, the more data collected on a given location, the easier it is to characterize and assess the risk profile. Unfortunately, more data has a cost associated with it, as collecting and processing the information (i.e., using the data in the insurance rating manual) takes time and effort.

The introduction of WMCs to the Florida insurance market has essentially pushed the market into a state of transitioning between one set of risk variables to another set of variables. In this report, the term "data fidelity" refers to the quality of different sets of variables used to classify the risk level. In the insurance-related context of this report, a set of variables that more accurately reflects the underlying risk level is deemed to have higher data fidelity than a set of variables this is less accurate.

Before the introduction of the WMC system, the primary factors for pricing residential wind insurance risk were coverage amounts, location (based on rating territories), construction, and age[10]. When the 2000 Florida statute (s. 627.0629 F.S. section 1) [31] was modified to expand mitigation credits, insurance companies were required to consider additional variables in their pricing methodologies, which include roof strength, roof deck attachment details, roof anchoring, wall-foundation connections, and opening protection. Thus, the pre-WMC set of variables are considered "low data fidelity", and the WMC variables are denoted "high data fidelity".

[10] Although other variables associated with rating plans like BCEGS and Fire protection classes also affect the premium charged, these tend to have a lesser impact than the variables noted here.

SECTION 2: LOSS RELATIVITY DEVELOPMENT USING CATASTROPHE MODELS

The windstorm mitigation credit (WMC) factors that are currently being used by most insurance companies in Florida were developed from a loss relativity study using a Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) certified model developed by Applied Research Associates (ARA). This study, completed in 2002 [3], used a methodology which calculated long-term statistical loss levels for building types, using a wind-load and resistance simulation methodology. An update of this study was commissioned on November 20, 2007 and delivered to the OIR in October 2008 [2].

During the FCHLPM hearings in the fall of 2009, questions arose regarding the validity of the hurricane model and the completeness in the original study. As part of this project, RMS was required to evaluate these two studies based on two different versions of the ARA hurricane model. In addition, RMS has completed an evaluation of the equivalent factors derived from the RMS® U.S. Hurricane Model. This section contains an overview of the two ARA studies and the study completed with the use of the latest RMS model. A discussion about the choices made in the original study is provided, and a comparison of results produced by the three models is presented. The review and comparisons are limited to single-family residential structures as defined in the ARA 2002 report and the analyses do not consider post-2001 construction or multi-family dwellings.

Credits versus Relativities

Before proceeding too far in the topic, it is important to define the terms “windstorm credits” and “windstorm relativities.” Numerically, both numbers are quite simple, but should not be confused with each other.

Catastrophe models are probabilistic estimates of the financial loss caused by hurricanes of varying size, intensity, and magnitude impacting properties at risk. One of their outputs is the average annual loss (AAL), defined as the average or expected loss for a property or a set of properties per year. This loss metric is used to develop windstorm mitigation relativity (WMR) factors that are defined as the ratio between the average loss cost (average annual loss divided by the value of the property (in thousands)) for a specific building configuration divided by the average loss cost for a reference building. The WMR for the reference building has a value of 1.00. Buildings that are weaker than the reference have a value greater than 1.00, and buildings that are stronger than the reference have a value less than 1.00. The choice of the reference building is referred to as a normalization point, and is usually chosen to be either the typical building or the weakest building.

The term windstorm mitigation credits (WMC) refers to the application of the windstorm mitigation relativities as an evaluation factor that is implemented into insurance rate plans. WMCs are equal to 0.0 at the normalization point (WMR 1.0) and approach 100% as a building is hardened to a stronger point.

To calculate the equivalent wind mitigation credit from the wind mitigation relativities, the following formula is used:

$$WMC = 1 - \frac{WMR}{N}$$

where N is the normalization ratio from the WMR table.

If the normalization point is selected as a typical building, then N will be 1.0, and weaker buildings will have WMR that are larger than 1.0 and the corresponding WMC will be a negative number indicating a surcharge with respect to the typical building. If the WMCs are normalized to the weakest building, then the weak building will have a WMC of 0, and all other buildings will be positive values that approaches 1.0 as the buildings get stronger. Figure 3 shows a comparison of equivalent relativity and credit factors on an illustrative set of tables. Factors in the lower right represent strong buildings, and the upper left represent the factors for the weakest building.

Wind Mitigation Relativity (WMR)

Weak

2.37		
	1	
		0.41

Strong

Wind Mitigation Credit (WMC)

- normalized to Typcial Building

Weak

-1.37		
	0	
		0.59

Strong

Wind Mitigation Credit (WMC)

- normalized to Weak Building

Weak

0		
	0.58	
		0.83

Strong

Figure 3: Comparison of equivalent wind mitigation relativity factors and wind mitigation credit factors with different normalization points.

Summary of Loss Relativity Methodology

2002 ARA study

The 2002 ARA study followed an approach which created a set of simulated buildings with a variety of specific engineering component attributes. Over 1,000 unique combinations of individual building simulations were completed for each of the 31 locations shown in Figure 4. For each building, the model calculated the average annual loss ratio per year and presented results relative to a typical building in the state. The determination of the typical building's location on the WMR matrix was established through analysis of a set of field inspections and tax record databases. The typical building was defined as having roof deck B, clip roof anchors, gable roof, a non-FBC approved shingle roof, and no opening protection.

The variables considered in the study are shown in Table 1. These attributes are key determinants of wind performance, as determined from reviewing engineering and scientific literature that document the failure modes of residential buildings following land falling hurricane events. This study was based entirely on one story buildings ranging in size from 1200 to 2050 square feet of living area with shingle roof coverings only.

It is known that wind losses have a high degree of sensitivity to the surface roughness surrounding a building, as high roughness actually reduces wind speeds locally. The different classifications of surface roughness are called "Terrain" categories in the building code. For the 2002 study, ARA chose to classify the terrain according to the definition contained in the 2001 Florida Building Code (FBC) [97][11]. Thus the relativity results are reported as an average for locations in Terrain C—open country exposures, and Terrain B—suburban exposures.

[11] Terrain C includes 1500 feet from the coastline and all of the HVHZ (Palm Beach, Dade, Broward, Monroe counties) and Terrain B is rest of Florida.

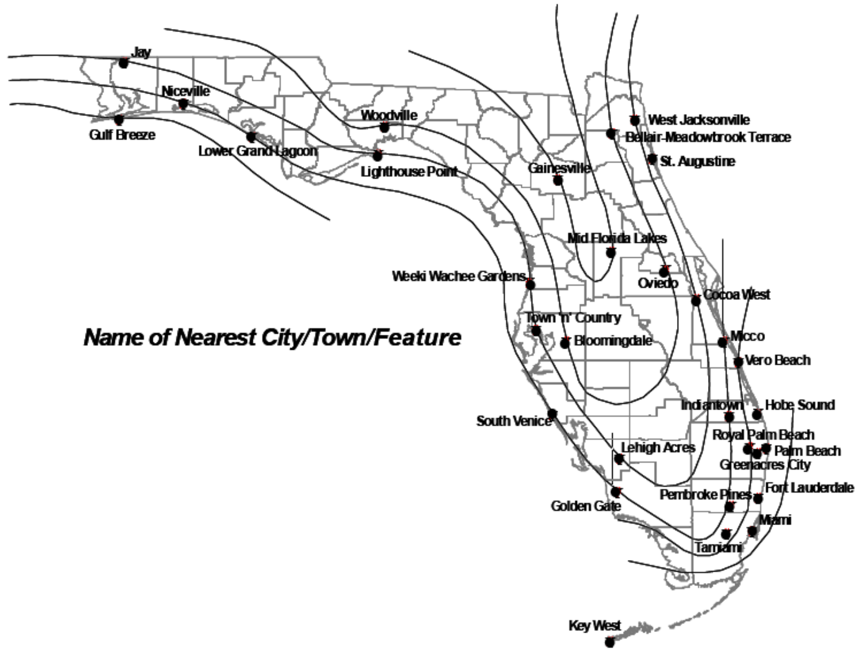


Figure 4: Study locations used in the 2002 ARA study [3]

Table 1 : Hurricane loss rating variables in 2002 ARA study

Variable	Primary or Secondary Variable	Option
1. Terrain	Primary	Terrain B, Terrain C
2. Roof Shape	Primary	Hip, Other
3. Shingle Strength ()	Primary	FBC (2001) approved, Non-FBC approved
4. Secondary Water Resistance	Primary	Yes, No
5. Roof-to-Wall Connection	Primary	Toe Nail, Clips, Single Straps, Double Straps
6. Roof Deck Material/Attachment	Primary	A, B, C
7. Opening Protection	Primary	None, Basic, Hurricane
8. Gable End Bracing	Secondary	Yes, No
9. Wall Construction	Secondary	Wood, Masonry, Reinforced Masonry
10. Wall-to-Foundation	Secondary	Yes, No

The results of the study were reduced by the modeler to a format that could be implemented by insurance companies as a series of multivariate state-wide tables of primary factors and secondary adjustment factors[12]. Tables were created for existing construction as well as new construction. The main two tables that are relevant to existing construction, which are also the basis for the OIR implementation of the windstorm mitigation credits, are shown in Exhibits A-1 and A-2 of Appendix A. The normalization point is highlighted in red on the tables in these exhibits.

The tables indicate that the expected hurricane losses for the weakest building in the upper left corner are 2.37 and 1.6 times the expected loss for the typical building in Terrains B and C respectively. The strongest buildings, in the bottom

[12] Note that further simplifications were made in reducing these results into the OIR recommended WMC tables by essentially ignoring all secondary factors proposed by ARA.

right corner of each table, are fractions of the typical building loss, which are shown to be 0.41 and 0.21 times the typical building losses for Terrain B and C. The table below shows a simplified version of the detailed tables in Exhibit A-1, highlighting where the weakest, strongest, and average buildings are in relation to each other on the matrix.

If these numbers are converted to credits and surcharges[13], the results suggest that the weakest building in the state (for Terrain B locations) would require a surcharge of 137%, and the strongest building would receive a 59% credit with respect to the average building.

Table 2: Illustration of WMR range and normalization points from Exhibit A-1

				Roof Shape			
				Other		Hip	
Roof Cover	Roof Deck Attachment	Roof-Wall Attachment	pening Protection	No SWR	SWR	No SWR	SWR
Non-FBC Equivalent	A	Toe-Nails	None	**2.37**			
			Basic				
			Hurricane				
		Clips	None				
			Basic				
			Hurricane...				
		Single Wraps	None				
			Basic				
			Hurricane				
		Double Wraps	None				
			Basic				
			Hurricane				
	B	Toe-Nails	None				
			Basic				
			Hurricane				
		Clips	None	**1.00**			
			Basic				
			Hurricane				
		Single Wraps	None				
			Basic				
			Hurricane				
		Double Wraps	None				
			Basic				
			Hurricane				
	C	Toe-Nails	None				
			Basic				
			Hurricane				
		Clips	None				
			Basic				
			Hurricane				
		Single Wraps	None				
			Basic				
			Hurricane				
		Double Wraps	None				
			Basic				
			Hurricane				
FBC Equivalent	A	Toe-Nails	None				
			Basic				
			Hurricane				
		Clips	None				
			Basic				
			Hurricane				
		Single Wraps	None				
			Basic				
			Hurricane				
		Double Wraps	None				
			Basic				
			Hurricane				
	B	Toe-Nails	None				
			Basic				
			Hurricane				
		Clips	None				
			Basic				
			Hurricane				
		Single Wraps	None				
			Basic				
			Hurricane				
		Double Wraps	None				
			Basic				
			Hurricane				
	C	Toe-Nails	None				
			Basic				
			Hurricane				
		Clips	None				
			Basic				
			Hurricane				
		Single Wraps	None				
			Basic				
			Hurricane				
		Double Wraps	None				
			Basic				
			Hurricane				**0.41**

2008 ARA study

The 2008 study completed by ARA included a redevelopment of the relationships for the variables in the 2002 study, and introduced additional rating variables, shown in a new set of WMC tables. Two of the variables—number of stories, and roof cover material—were added because they were known rating factors that had not been included in the 2002 report. In developing new relativity tables, a similar methodology was followed that included simulations of over 2000 combinations of primary rating variables at various locations around the state to make a series of statewide relativity tables for the same two terrain classes as the 2002 study. The 2008 ARA model included several updates, including changes to the wind hazard model, wind loading patterns on roof shapes to reflect different roof slopes, and a variety of other changes to component models used in the vulnerability models. The report also describes efforts to validate the model with claims data from the 2004 and 2005 storm seasons [2].

[13] To calculate the equivalent credit/surcharge (WMC) use the formula: WMC = 1 - WMR.

Table 3: Additional rating variables for single family residential in 2008 ARA study.

Variable	Primary or Secondary Variable	Options
1. Number of Stories	Primary	1 story, 2+ story
2. Roof Cover Material	Primary	Non-Tile, Tile
3. Roof Slope	Primary	Less than 5/12, greater than 5/12
4. Soffit Construction	Primary	Wood, Other
5. Vinyl Siding	Secondary	Yes, No
6. Window/Door Water Leak Potential	Secondary	Number of openings
7. FBC Roof Cover Age	Secondary	Interpolation to upper age limit as function of roof cover material

Comparison of the 2002 and 2008 Study

While the report presented new WMR tables based on the enhancements to the model and included a general discussion of the differences introduced in the new study, it was only in the January 28, 2010 memo [114] that ARA highlighted a side-by-side comparison of the 2002 and 2008 relativities for the structures that were similar in both studies. These tables are reproduced in Exhibit A-3 and A-4 of Appendix A in a WMC format that aligns with the OIR normalization point of weakest building. ARA noted that the credit factors in their 2008 report are actually quite different from the 2002 study. RMS has extracted the equivalent WMR factors from the 2008 report that correspond to the WMC factors in Exhibit A-3/A-4. These WMR factors are included in Exhibit A-5/A-6. The table below shows that the upper range of the WMR for the weakest buildings dropped significantly in the new study because of the 2008 model revised a toe-nail strength assumption. Note that the relativity of the strongest structures is roughly the same now in both terrains. Examination of the Exhibits in A-5/A-6 indicates that buildings that are more typical (i.e., Roof Deck B, Roof anchor Clips and straps) have only changed on a WMR basis by 10-15 percentage points. There are large differences for the toe-nail cases where the relativity is now almost half of the previous study.

Table 4: Comparison of WMR range for similar structures in 2002 and 2008 ARA studies – normalized to typical building (= 1.0)

	Terrain B		Terrain C	
Model	**Weakest**	**Strongest**	**Weakest**	**Strongest**
2002 ARA	2.37	0.41	1.60	0.21
2008 ARA	1.57	0.44	1.57	0.30

Choice of Normalization Point and Sensitivity to changes in Hurricane Model

The comparison of the 2002 and 2008 results allows for the exploration of how the selection of the normalization point changes the resulting WMC tables when model changes occur. When the WMCs are normalized to the weakest building, then any changes in the modeling framework, assumptions, or model data have the potential to create more significant changes in the extreme parts of the model than in the typical range. Exhibit A3 illustrates how a change in the weak building now indicates that the WMCs for all other buildings are potentially overstated by as much as 25%. The table below illustrates this point by comparing the wind mitigation credits calculated with respect to the weakest building against the same credits calculated with respect to the typical building. The two buildings show the appropriate credit associated with putting shutters on two examples of gable and hip roof buildings. Table 5 shows that the differences in the recommended credits would have changed by only 10% instead of 25% if the normalization point was based on the typical building.

Table 5: Illustrative example showing how normalization point affects change in WMC as models evolve

	WMC with respect to Weakest building			WMC with respect to Typical building		
Building	**WMC in ARA 2002**	**WMC in ARA 2008**	**Difference**	**WMC in ARA 2002**	**WMC in ARA 2008**	**Difference**
A	68%	43%	- 25%	20%	10%	-10%
B	73%	55%	- 18%	37%	30%	-7%

A = building with Non FBC roof, No SWR, Deck B, Clips, hurricane Shutters, Gable Roof, terrain b
B = building with Non FBC roof, No SWR, Deck B, Clips, hurricane Shutters, Hip Roof, terrain b

Expansion of loss ranges

The loss relativities from the 2008 ARA study demonstrated that the 2002 study did not reflect the full range of possible loss results in the residential building stock. The new study also showed that two-story homes were shown to have approximately twice the loss levels as the one-story homes. The study also demonstrated significantly higher losses for tile roofs than shingle roofs (approximately 75%), and lower losses for steep-slope buildings, than in the 2002 study. In general, the new variables introduced in 2008 pushed the losses for the weakest version higher than the 2002 study—particularly for Terrain C locations. Conceptually, this is illustrated in Figure 5 where the green section represents the WMC table from the 2002 study, and the purple section represents how the additional rating variables have expanded the upper range of loss relativities without affecting the strong building significantly.

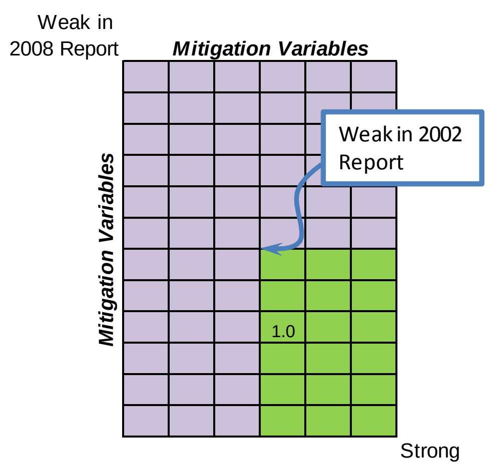


Figure 5: Illustration of how ARA 2008 study expanded range of loss relativities.

The change in the relativity ranges is shown in Table 6. Using the same normalization point as the 2002 study, these new variables indicated that the weakest buildings were approximately 3 times the typical building instead of 2.5/1.6 times the weakest building. This is a significant increase in the relativity range, particularly for the Terrain C locations.

Table 6: Comparison of total relativity range between 2002 and 2008 ARA studies – normalized to typical building – full matrix

	Terrain B		Terrain C	
Model	**Weakest**	**Strongest**	**Weakest**	**Strongest**
2002 ARA	2.37	0.41	1.60	0.21
2008 ARA	3.2352	0.4287	3.0941	0.3001

The upward push on the loss relativity range is most significant when combined with information about the population associated with the new rating variables—two-story buildings and tile roofs. RMS estimates that the proportion of the population that lies outside the original 2002 study scope is about 25%. Given that these new variables generally increased losses, one may conclude that almost one quarter of the population, should they all be inspected, could be receiving credits when in reality they may actually have higher loss expectancy.

RMS® U.S. Hurricane Model

The RMS U.S. Hurricane Model is also an FCHLPM-certified model that is designed to simulate average annual loss ratios for individual buildings and portfolios of buildings. The hazard model is based on a set of simulated storms that models the lifecycle of each storm to create a realistic representation of the direction, path, and intensity of hurricane events as they affect different parts of Florida. The probability of landfalls is calibrated against historical rates of occurrence as reported in the HURDAT database. The wind field model calculates the maximum wind speed for each of the simulated events at each location, which relates directly to the damage caused. It includes a time-stepping model that incorporates the effects of surface roughness on the wind speeds. The RMS vulnerability model utilizes a component methodology and has been validated with over 9 billion dollars of claims data from past events. The variables from the RMS model and how they map to the requirements of the Florida Statute 627.0629 (1) (a) are listed in Appendix D.

RMS has reviewed the rating variables used in the 2002 and 2008 ARA reports. The RMS model can model all of the individual characteristics described in these reports in a manner similar to the ARA model.

There is one variable in the RMS model that is not identified as an important rating factor in either of the ARA studies—living area. RMS introduced this variable into its model in 2006 after claims analysis forensics showed that loss ratios for larger size buildings are almost half of the loss ratios for smaller buildings. This is due to the different rate at which peak wind loads increase relative to the increase in value of the building as the size increases. The effect of living area size on loss ratios can be larger than some of the other variables included in the current WMC tables like Secondary Water Resistance, and therefore RMS recommends that this be included in future versions of WMC implementation.

RMS also concludes, based on its model, that the scope of the variables in the 2002 loss relativity result set was too limited to reproduce the full range of loss results for the residential building stock. As noted in the 2008 ARA study section above, failure to capture variables that further differentiate the risk may lead to providing larger credits than warranted for some of the population.

Comparison of ARA 2002 Relativities to RMS Mitigation Relativities

In order to determine if the catastrophe model used to develop the original loss relativities has contributed to the reported premium degradation, a comparison between results from the RMS model have been made. RMS has completed an analysis of loss relativities using the same locations and building configurations as in the 2002 ARA study to establish how different the relativity factors would have been had they been developed using an alternative model. The comparison is designed to provide a direct apples-to-apples comparison, and therefore RMS has used the same analysis parameters outlined in the ARA report, including creating WMR tables for the locations defined as Terrain C and B in the ARA report. This analysis also normalizes the WMC factors to the weakest building to make the comparison to existing WMC tables as direct as possible. As previously noted, other variables should be included in the WMC or base rate tables of an insurance rating plan that are not included in this analysis.

The side-by-side comparison of the WMR normalized to the ARA typical building is presented in Exhibits A7 and A8. Exhibits A9 and A10 show the wind mitigation credits normalized to the weakest building.

Range

Overall, the relativity range reflected in the RMS model is larger than the ARA model as shown in Table 7 below. This table shows relativity to a typical building. RMS demonstrates a higher relativity for the weakest building, having a relativity of 3.18 and 2.59 for Terrains B and C, respectively, compared to respective values of 2.37 and 1.60 from the ARA study. The differences for the strongest buildings are much smaller in magnitude, particularly for Terrain C, indicating generally more agreement between the models for hardened homes.

Table 7: Comparison of range of wind mitigation relativity factors in ARA 2002 study and the RMS U.S. Hurricane Model – normalized to weakest Building (=1.0)

	Terrain B		Terrain C	
Model	**Weakest**	**Strongest**	**Weakest**	**Strongest**
ARA	2.37	0.41	1.60	0.21
RMS	3.18	0.21	2.59	0.26

The fact that there is more agreement between the models at the strong end of the scale reflects how hurricane claims data are often presented to modelers. Very rarely will claims data sets have uniquely identified attributes on an individual building basis. However, they will often have the year built identified, which means that modeling companies are able to isolate the cumulative effect of combinations of hardening features related to age and building code requirements (i.e., strong buildings) relatively easily.

RMS notes that the relativity trends are similar in both models. As buildings are hardened, the relativity factors get smaller. There are differences in the magnitude of individual relativities or credits for individual building configurations. The following observations from Exhibits A9 and A10 can be made about the magnitude of differences between the WMC derived from the two models:

- For typical structures which have roof deck attachment B, no FBC roof cover, and clips or straps for roof anchors, the credit factors are approximately 10–20 percent larger for the RMS model than the ARA model.
- The 2002 ARA credits are 0-20 percent larger than the RMS credits for toe-nail roof anchors in Terrain B, and within +/- 10 percent of each other for Terrain C.
- RMS credits are smaller for FBC-approved roofs installed on the weakest roof deck
- For buildings with new roofs, the 2002 ARA results suggest more credits in Terrain C, but fewer credits in Terrain B than the RMS model.
- The difference between the credits at the bottom right of the WMC tables decreases to approaching differences of 5% in Terrain C.

Overall differences between the modeled windstorm mitigation credits can be as much as 25% for the more common structures in the state. Figure 6 shows a plot that compares the WMC factors from Exhibits A9 and A10. Notice that the differences between the factors become smaller as the credits become larger supporting the observation that the differences are smaller for more hardened structures than for the weaker structures.

Because RMS does not have access to the ARA model, it is not possible to determine exactly why there are differences between individual results. Possible factors could include differences in assumed component strengths, relationships between component damage rates and damage thresholds, different treatment of surface roughness in wind speed estimates, and differences in hazard models, amongst other things.

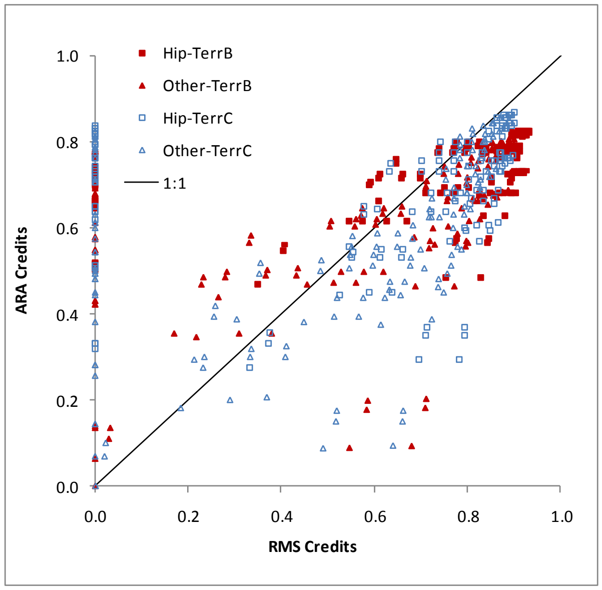


Figure 6: Comparison of WMC normalized weakest from 2002 ARA versus RMS

Discussion

The following discussion points regarding the choices and assumptions in the development of the WMR from a catastrophe model are presented as topics below:

Interaction of Variables

Wind losses are dependent on the integrity of the building envelope, which means the problem of estimating loss levels has elements of a "weakest link" problem. This means that the strength of a single component must be considered with respect to other components, and hardening one element will have a different relative impact depending on the other element strengths. The methodology employed by ARA appears to take these effects into account. In order to deal with the interrelatedness of the variables, ARA created a matrix of the primary variables and estimated the change in loss levels for each of the unique combinations of variables as shown in Exhibits A1 and A2. Thus, the benefit of each variable is dependent on the starting condition of the building—for example, as shown in Table 8, upgrading roof anchors on a gable roof building, which has higher wind loads, has a bigger net impact than the same upgrade on a hip roof building. The difference in loss relativity for the gable roof is much higher than for the hip roof.

Table 8: Comparison of change in 2002 ARA relativities when roof anchor is upgraded on a gable versus hip roof. Data extracted from Exhibit A1.

	Roof Shape	
Configuration	**Gable**	**Hip**
Building X with Toe-nail	2.16	1.22
Building X with Single Straps	0.95	0.75
Difference	1.21	0.47

Building X is in Terrain B and also has Deck Type B, Non FBC roof cover, No Opening Protection, and No SWR

This complex interaction between variables precludes the creation of credible single-variable credit factors for specific hardening features. Thus, RMS finds that in principle, a relativity table that accounts for the interaction of several variables at once is a necessary feature to include in the implementation of WMC tables, as implemented in the 2002 tables.

Choice of Rating Variables: New construction versus Existing Construction

Due to the interaction of the variables mentioned above, the variables introduced in the 2002 ARA and 2008 ARA studies include several characteristics that may not be explicitly related to hardening, but are nonetheless important variables for proper wind risk classification. For example Table 9 lists RMS' recommendations of primary variables from the 2002 and 2008 relativity studies that RMS recommends be used, along with the RMS assessment of the feasibility of a single-family homeowner to change that attribute on an existing building. Four of the 11 variables—roof shape, terrain (location), roof slope, and number of stories—are variables that cannot be changed. The other variables can be changed as part of the regular maintenance cycle of a building (roof cover), or a project to harden the structure.

The variables that are not actionable retrofit items are important to retain in the implementation because they 1) are necessary to make sure the relativities of the other variables are correct, and 2) to promote construction practices and choices for new construction. For example, having insurance prices that provide potential benefits for hip roofs can provide an appropriate signal to more consumers and builders to consider this roof shape at the time of construction.

Table 9: RMS recommended WMC rating variables.

Variable	In OIR WMC table	Actionable mitigation item on existing building?
Location dependence	Existing	No
Roof Shape	Existing	No
Shingle Strength (FBC vs. NonFBC)	Existing	Yes
Secondary Water Resistance	Delete	Yes – doubts about impact – combine with Shingle Strength
Roof-to-Wall Connection	Existing	Yes
Roof Deck Material/Attachment	Existing	Yes
Opening Protection	Existing	Yes
Number of Stories	New	No
Roof Cover Material	New	Yes
Roof Slope	New	No
Soffit Construction	New	Yes
Living Area	New	Yes

Note that secondary water resistance (SWR) is not included in the list of recommendations. Although this feature is considered in the RMS model, and provides positive credit, the RMS assessment is driven from a practical implementation viewpoint than a strictly technical view. The original premise for secondary water resistance was conceived as a self-adhering tape product that would stay attached to the roof deck when the shingles and tar paper were blown off the roof. However, RMS notes that in the High Velocity Hurricane Zone which includes the counties of Dade, Broward, Palm Beach, and Monroe, the code was modified to prevent this particular application. In these counties, the self-adhering tape is applied on top of the tar paper, making it less effective, thus, the application of SWR has been curtailed. RMS also notes that the model results in the 2002 WMC tables, and even our own model results, indicate that SWR has a small effect on loss costs so the complexity of keeping this variable in the rating tables is not worth the cost associated with verifying and collecting this information. Although not studied here, this simplification may also help reduce errors associated with wind mitigation inspections.

Note that this study does not contain enough information to formulate new recommendations for WMC tables. The timeframe and scope of the work does not allow for the reduction of model results into a new WMC table format. This report simply highlights the need for further work.

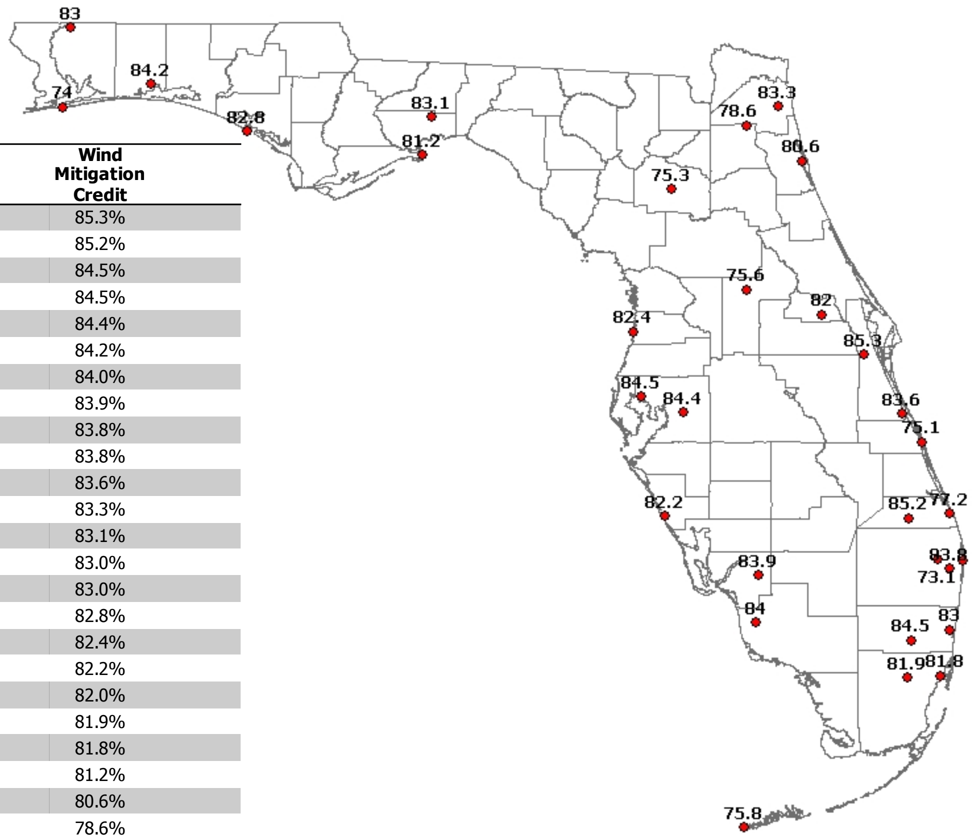
Effect of Terrain and Geographical Variations:

Wind loads demonstrate a high degree of sensitivity to the surface roughness surrounding a building. As the roughness decreases, the wind speeds affecting a building generally increase. All models approved by the FCHLPM need to account for the effect of surface roughness in the development and implementation of the hazard model. Surface roughness is a very location-specific feature—it depends on the distance to the coast, wind direction, and what kind of obstacles and how many obstacles are upstream of the given site (obstacles can be trees, buildings or other features of the landscape).

In the 2002 study, ARA uses two terrain classes as defined by the 2001 Florida Building Code (FBC)[14] to create two distinct relativity tables. There has been some confusion regarding the use of these terrain classes, with some suggestions in the industry that the fact that the WMC tables only have two terrains is a gross simplification of the actual surface roughness variations that exist in the state. RMS notes that the introduction of terrain in the WMR matrix is *not* a statement of the number of roughness classes incorporated into the ARA hazard model but simply a method of logically grouping different geographic locations in the state together. For most of the state, the groupings end up being coastal and inland locations. Thus, in this context, terrain classes are more an assumption related to the geographic variations of the relativity rather than determinations of the vulnerability at a location.

What does this mean for the relativity tables developed in these studies? RMS examined the change in the WMC for a fully hardened structure at different locations around the state. RMS analyzed the 31 locations used in the 2002 ARA report with the building characteristics associated with the weakest and strongest buildings[15], and calculated WMC normalized to the weakest building. The WMCs associated with each location are shown in the table and map in Figure 7. This exhibit shows the geographic variation of this single entry in an equivalent WMC table. The credit can vary from the lowest to the highest location by about 13%. This indicates that a averaging this particular WMC for this building configuration are +/- 6% of a statewide average.

[14] Terrain C is 1500 feet from the coastline and all of the HZHV (Palm Beach, Dade, Broward, Monroe counties) and Terrain B is everywhere else.
[15] Each location was a mitigated and unmitigated wood-frame house with year built of 1990. The mitigated building was given an FBC equivalent roof cover with the strongest roof-deck attachment (C), double wrap roof anchors, and hurricane shutters aligning it with one of the strongest points on the WMC table. The unmitigated building was given a non-FBC equivalent roof cover, the weakest roof-deck attachment (A), clip roof anchors, and no opening protection



Postal Code	Wind Mitigation Credit
32926	85.3%
34956	85.2%
33332	84.5%
33615	84.5%
33596	84.4%
32580	84.2%
33999	84.0%
33976	83.9%
33411	83.8%
33454	83.8%
32976	83.6%
32225	83.3%
32362	83.1%
32565	83.0%
33302	83.0%
32411	82.8%
34607	82.4%
34293	82.2%
32766	82.0%
33194	81.9%
33128	81.8%
32346	81.2%
32085	80.6%
32073	78.6%
33475	77.2%
33040	75.8%
34789	75.6%
32603	75.3%
32963	75.1%
32561	74.0%
33402	73.1%

Figure 7: Windstorm Mitigation Credit (normalized to weakest home) for Mitigated versus un-mitigated wood frame house at a variety of postal code locations around Florida

ARA also examined this issue in its 2008 report by looking at the variations of all the entries in the WMC tables. ARA notes that the error associated with geographic averaging of the WMC into a single statewide table carries an average credit difference (without any weighting for actual exposure) of approximately +/- 2 percentage points, but some locations can vary by as much as +31% to -22%. The range in this example can be expected to be larger since the ARA comparisons are done for all the locations in the WMC table instead of just the fully mitigated case in the RMS example.

From these two examples, RMS concludes that WMC tables should not be produced as single statewide WMC tables, as there are important territory-specific differences in predicted credits that can be as large as 20–30 percent or more. In other words, instead of creating single tables for two terrains, insurance companies should be encouraged to create a series of relativity tables for each territory so that these location-specific variations can be captured effectively.

Summary

This section examined the development of windstorm mitigation relativity factors in the 2002 ARA study. Comparisons were made to the 2008 ARA study which expanded the scope of the relativity factors and also to the RMS U.S. Hurricane Model. RMS has found broad agreement between the credits derived in all three studies, noted the following:

- The interaction of the rating variables and mitigation hardening variables makes it nearly impossible to create mitigation credit factors that are independent of each other. The relativity matrix concept proposed in the 2002 study is an acceptable way to reflect the interaction between the key rating variables that are captured in these catastrophe models.
- The comparisons of the RMS model to the 2002 WMC indicate that there is broad agreement in trends and ranges of the two models. However, differences between individual WMC entries in the table can be 25 percentage points higher or lower between the models, especially for the weakest of the buildings. Differences between individual WMC entries are smaller as buildings become more hardened.
- Although there are differences between the RMS and ARA model outputs, the difference is not dramatic – and as illustrated in later sections, these differences are not the primary driver of premium degradation observed in recent years.

Recommendations

- RMS recommends that insurance companies develop alternate WMC tables with FCHLPM approved models. The 2002 study, upon which the current OIR recommendations are based, does not include some key rating factors such as number of stories, roof slope, roof covering type, and living area. Many of these variables suggest higher losses than the 2002 relativity study. Ignoring these factors could lead to overstatement of credits for approximately 25% of the population.
- The WMC tables can be improved by creating more geographically granular versions of WMC tables. When WMCs are averaged across broad areas, the average credit varies only a few percentage points, but differences between the statewide average credit and location specific values are generally only a few percent on average, but can be over or under by as much as 25% for some locations. Instead of using terrain to classify which locations to group together, these tables should instead be developed for specific, more geographically granular rating territories.
- RMS recommends that new WMC tables be normalized to the typical building, as defined by the catastrophe model, which is a more robust methodology that will minimize changes to the WMC table when models are upgraded and improved over time. Catastrophe models are generally developed with data and observations that lead to more stability in estimates of average or typical buildings - not the weakest portion of the building stock.

SECTION 3: CONVERTING LOSS RELATIVITIES INTO WIND MITIGATION CREDITS

The mechanics of how the 2002 ARA relativity study results were translated into recommended mitigation credits are relatively straightforward and documented in Informational Memoranda (OIR-02-0470M dated June 6, 2002 [110]). Section 1 described how the 2002 ARA WMR factors were renormalized to the weakest building on the table, and compressed initially until the Financial Services Commission adopted a rule in 2006 to remove the original compression in the OIR recommended tables. Thus today, most insurance companies have WMC tables which start at 0 for the worst building and show credits as large as 88% of the wind premium. Note that the wind premium is only a part of the total premium (which includes premium for fire and theft amongst other things), and thus the credit to the homeowner is not 88% but approximately 50%. A copy of the current WMC table is shown in Exhibit A11 of Appendix A.

This section includes discussions about the choices made in the implementation, as well as an exploration of the unintended consequences of the some of these choices.

Re-classification versus Hardening

A fundamental flaw in the 2000 statute was the assumption that the variables suggested were associated with credits only. This interpretation is perfectly understandable – in 2000 there was a desire to harden homes to reduce absolute risk levels, and these features, when strengthened, are known to accomplish that objective. The events of 2004 and 2005 provided more evidence to support this concept. So why shouldn't these variables equate to a credit insurance rates?

The difficulty is that that these variables are interrelated, and already exist in the population in various states and proportions. Therefore the WMC variables do not necessarily equate to purely credits with respect to the "average" risk used for the pricing of wind insurance. In other words, some of the features like 6d nailed roof decks are worse than the "average" and therefore should have been surcharged with respect to the average price at that time before hardening.

Exploring other insurance sectors, examples can be found where a mitigation variable does equate to an insurance credit only. One example is seat belts in the auto industry. When seat belts were introduced into cars in the 1950s by Robert MacNamera [52] they were an answer to an escalating death rate associated with auto accidents. If an insurance company introduced an insurance credit associated with seat-belts at the time, then they did so when 1) there were virtually no seat belts in cars and 2) their benefit was, let's assume, relatively uniform across all risks. In other words, putting a seat belt in each car resulted in the same reduction in the number of deaths regardless of the car. This concept is represented by the two lines in Figure 8. Line A represents the range of risk - in this case, risk of auto deaths in the population before the introduction of seat belts. Then the seat belt credit, applied uniformly to everyone, introduces a shift downward in the range, shown as Line B. The overall risk is less and so is the average risk (red lines). Over time, as seat belts became mandatory and appeared in almost every car, the insurance credit disappeared as the base insurance rate automatically had the presence of seat belts "baked" into it. In this case, the insurance "credit" helped drive the adoption of new loss reduction techniques as well as legal requirements.

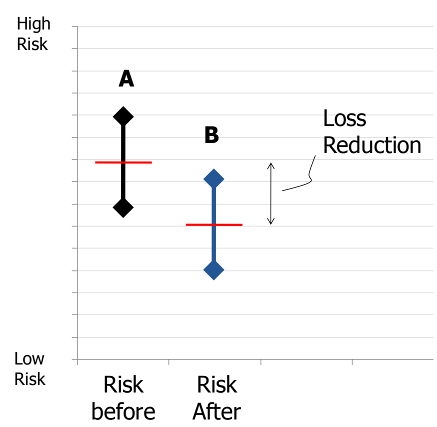


Figure 8: Illustration of how the range of risk levels shifts downward with mitigation variable that is a uniform credit

For the WMC situation, the problem is that the underlying population cannot be described as being largely absent of the WMC rating features. So when these attributes were assumed to be credits, some of the "credits" were associated with a re-classification of the underlying population, and not necessarily with hardening of the risk. It is this key point that puts the primary insurance companies into a bind. If the premium levels are dropping in the portfolio, how do we know that the drop is due to hardening, or just reclassification? If the cause is reclassification then the expected loss will remain the same, with fewer premiums to cover them.

Figure 9 below depicts this concept within the current Florida market scenario. On the left side of the figure, Line A represents the range of actual risk levels in the market – the true risk. Line B, beside that line shows the range associated with charged risk levels – i.e., the price charged - before the introduction of the WMC variables. The range associated with Line B is smaller than Line A because wind insurance has not traditionally been priced according to wind features, but instead has used a simpler set of variables (i.e., construction, total insured value, and location). Line C represents the application of the WMC factors where the top of the line represents the weakest building and the bottom the strongest building in the relativity study. Aligning the top of Line C with the average of Line B represents the normalization to the weakest point. Note that the bottom of the yellow line drops below the actual risk level indicating that some risks could be below Line A unless the average of Line B charged per risk rises. The last line on the right, Line D, shows the range for the portfolio after the application of the WMC. Note that there is a distinct misalignment between the charged risk (Line D) and the underlying actual risk (Line A).

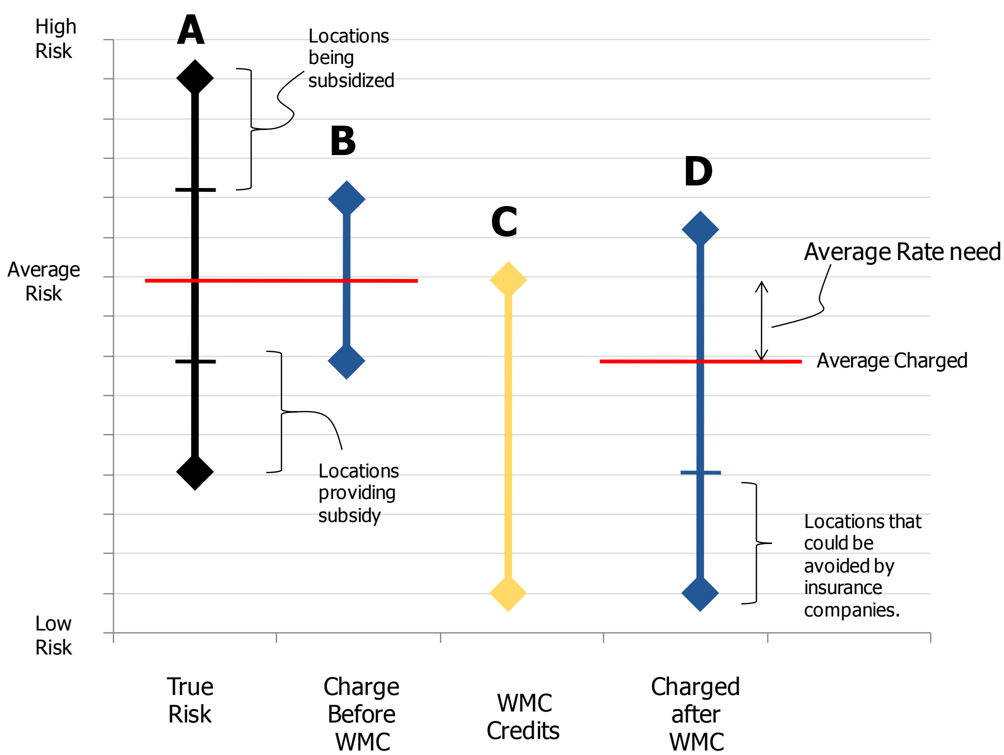


Figure 9: Illustration of how charged risk level has changed after the introduction of WMC variables.

Choice of the Normalization Point

As mentioned earlier, the WMC table was developed by normalizing the credits relative to the "weakest" building (i.e., least resistant to wind damage). At the August 2009 FCHLPM hearings, the OIR testified that this choice was mandated by the language in the 2000 statute, and the WMC table is being used in conjunction with insurance "base rate" tables, which are premium amounts for the average risk in a territory – not the weakest building. It should be noted that the weakest building normalization point represents is representative of only 1% of the building population and that 99% of the buildings are stronger than this building. This means that WMCs are being applied to an average rate for premium calculations, but the corresponding credit is relative to the weakest building.

Theoretically, before any buildings are reclassified under the WMC system, the choice of normalizing points in the relativity matrix does **not** matter, **if** a mechanism for adjusting rates for the remaining policyholders exists as re-classification takes place in the portfolio. The OIR testified that the choice of the weakest building for the normalization point was selected to comply with the Florida statute 627.0629 section (1) (a).

There did appear to be an understanding at the time that this normalization point was disjointed from the base rate tables typically used by insurance companies. OIR testified that the expectation was that as a company collected WMC information that adjustments would show up in subsequent rate indications as premium levels and expected loss levels changed.

However, since the introduction of the fully indicated WMC table in 2007, the regulatory environment currently is missing a practical mechanism for filing any offsets. Initially, an emergency rule implemented in December 2006 (FSC rule 69O-170.017) prevented offsets from being introduced. Even after the expiration of the rule, the requirements on the insurance companies to demonstrate the need for an offset carries a burden of proof that is difficult to meet.

Fundamentally, the problem lies in determining the degree to which premium degradation is due to reclassification of risk (which would logically require an offset to counteract the effects) versus real hardening efforts happening in the state (which would not require an offset). To make that determination, a company needs to know what the underlying population in their portfolio looks like before the application of WMC (Line A in Figure 9), and measure how much that is changing over time. For most companies, this has been very difficult, as proper characterization of the underlying distribution requires inspecting either the entire population, or at least a statistically rigorous representative sample.

Data Collection

Data collection with respect to WMC has been completed in two different ways. However, both require an appointment-based inspection regime. Between the original implementation of wind credits in 2003 and 2007, private inspection firms dealt directly with homeowners to inspect and document the presence or absence of the mitigation features on a house, and then the homeowner would submit the completed form to their insurance company to receive any credits that applied. Note that if there were no credits, it was unlikely for the homeowner to submit the information to the insurance company. The wind inspector needs to get access to the attic of the house in order to ascertain the details of the roof deck and roof anchoring properly, and they need to verify that opening protection exists on all windows and doors. The cost associated with these inspections is between $100 to $150 dollars per inspection.

Between 2006 and 2008, the state ran a public inspection program as part of the My Safe Florida Home (MSFH) program that offered free inspections to promote hardening of the building stock after the 2004 and 2005 storm seasons.

Because of the MSFH program, the private wind mitigation business dried up while approximately 400,000 inspections were completed in that time. The MSFH program included a training program and quality assurance program to ensure a consistent method of data collection was followed. These inspections represent approximately 10% of the population. Participation in the inspection program occurred as a results of a marketing program that encouraged homeowners to sign up for the inspection. Note there was also a grant program that assisted with some of the costs of hardening for low-income homeowners. Since then, the MSFH program has been unfunded and therefore the re-emergence of the private sector inspection offerings has arisen again.

It's important to recognize that the WMC data in the market is being collected on a voluntary basis. The home owner must decide if they are willing to engage in the inspection process, and then secondly if they think that it is worthwhile they will submit the information to the insurance company. If it turns out that the credits are not present, or too small, then the homeowner will not report this information to the insurance company.

Figure 10 shows a comparison of the attributes in the MSFH data set against industry averages, and indicates that there is a bias toward larger square footage, with more hurricane shutters than the general population in the data set. Voluntary reporting of WMC has an inherent bias, or asymmetry, that is likely to focus on only those homes that are either high value, highly mitigated and hardened already, located in a high hazard zone, or combinations of all three. As discussed in subsequent sections, this asymmetry has implications on the use of the WMC data in catastrophe models, rate filings and reinsurance pricing.

Other Implementation Issues of WMC Factors

Other issues relating to how companies applied these new tables between 2003 and 2006 were identified in the Windstorm Mitigation Discount Report from the FCHLPM. It is assumed that these items have been corrected by insurance companies and are not significant any longer. Therefore, this list is not exhaustive, and issues have been included here if the impact was quantifiable, or continued as outstanding issues that require more research outside this report scope.

Basis of the WMC

In the FCHLPM hearings on September 17, 2009, the OIR testified that there were situations where insurers have not applied the WMC tables to the portion of the wind premium which is applicable to the expected losses from hurricanes only, but has been applied to the whole wind-related premium. To ascertain the magnitude of the potential difference, RMS has evaluated how the WMC tables are being applied with a function form shown in the following equation:

$$Premium = Base\ Rate * Key\ Factor * (1 - \%Wind * WMC)$$

Where the product of the base rate and the key factor represents the total premium without any wind mitigation credits[16], and the %Wind is a fraction which represents how much of the total premium is allocated to wind losses (which includes hurricane losses). The %wind factor is developed by each company based on their calculations of the relative contribution of the wind and non-wind portions to the total premium in their portfolio.

One might question whether the WMC, which has been derived from a hurricane catastrophe models should be applied to the total wind portion which is equal to hurricane plus other "wind storms." Although the magnitude of the benefits of the WMC might be different than the hurricane portion, RMS considers that application of these credits to the "other wind" portions is generally appropriate as the hardening features for hurricane losses are also applicable to other wind events and therefore would reduce wind-related damage from all types of windstorms.

[16] Note there are other adjustments like protection classes, and BCEGS ratings in most rating manuals after this point in the calculation, but this equation is considered to be representative for the purposes here.

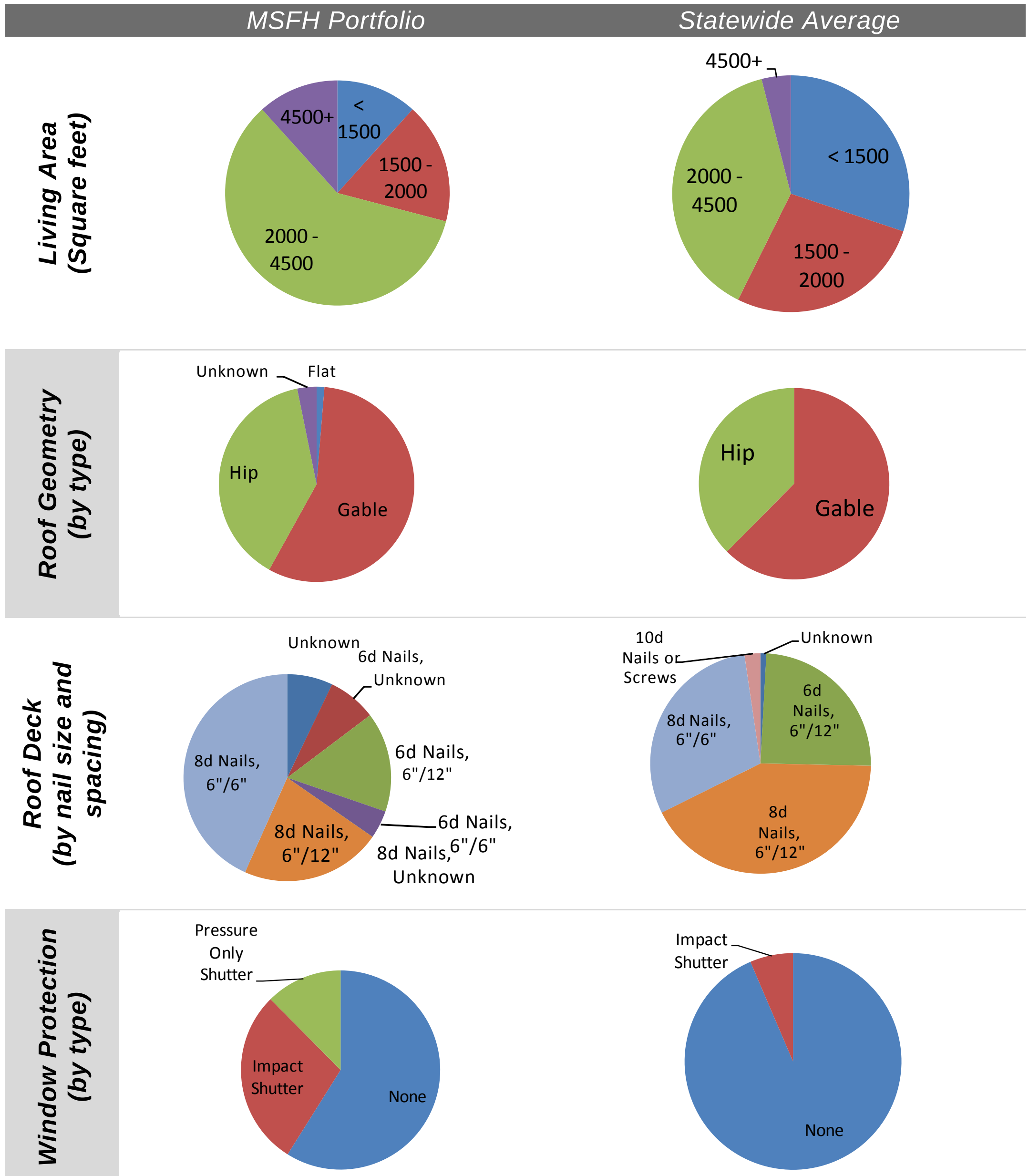


Figure 10: Key characteristics of the MSFH portfolio versus the Florida statewide building stock: size of living area (in square feet); roof geometry (by type of roof); roof deck construction (according to nail size and nail spacing); window protection (by type)

As suggested in the OIR testimony, RMS has examined whether removing the fixed expense portion of the wind premium would materially affect the amount of the credits. RMS assumes that the wind percentages in most rating plans do include portions of the fixed expense, and net reinsurance costs. Using typical policy amounts for each county, and following the methodology in Section 4 to breakdown the insurance premium into the components of fixed expenses, variable expenses, net reinsurance and incurred loss, RMS was able to state what the equivalent credit on the total premium would be should the basis to which it applies be smaller. In other words, two versions of %wind were recomputed – one that included fixed expenses and one that does not include fixed expenses. The results of such calculation are shown in Appendix C, and are plotted in Figure 9. Our results indicate that for small WMC levels, the difference is less than 1%, and thus negligible. However, for the larger WMC credits (under the current OIR recommendations [104]), the overstatement associated with changing to a smaller basis can overstate the credits by almost 10% of the total premium for some northern counties, but is typically less than a few percent in southern high hazard areas where the fixed expenses are a smaller portion of the total premium. This illustrative analysis suggests that insurance companies should investigate the basis to which WMC factors are applied in their rating manual as they may be overstated by as much as 10%.

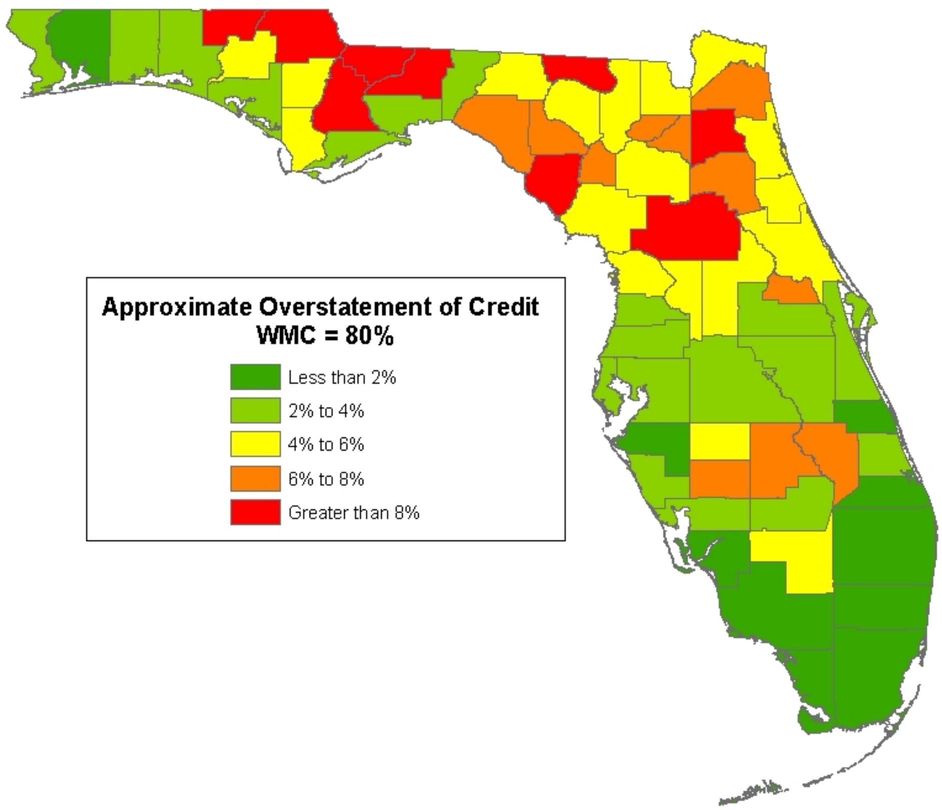


Figure 11: Map of possible overstatement of credit for typical policy per county, with respect to 80% credit level by including fixed expenses in the basis to which WMC are applied.

BCEGS and WMC: Possible Double Counting Effect

Insurance companies in Florida are required by statute to provide rate differentials based on the rating system called the Building Code Effectiveness Grading System (BCEGS) as published by ISO. This program started in the late 1990's after hurricane Andrew hit Florida. The Building Code Effectiveness Grading Schedule (BCEGS®) assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. The program assesses the quality of the code enforcement within a community at various snapshots in time. The program is described as an evaluation that applies on a community basis to any buildings built on or after the evaluation. The BCEGS rating is a proxy for specific construction practices that are enforced within a jurisdiction. It does not involve a structure specific evaluation, and is therefore not designed to apply to older structures in general.

It was recognized by the OIR in 2002 that the implementation of WMC possibly duplicated the effect of the BCEGS. Their Informational Memorandum OIR-03-001M issued January 23, 2003 [99] suggested a tempering of the BCEGS amount by 25%, and later suggestions of capping associated with the greater of the two was implemented in many insurance plans. Because both the WMC and the BCEGS are mandated by statute, OIR is not allowed to suggest that one program eliminates the need for the other.

RMS recommends that the BCEGS rating be dropped entirely for a specific structure if information on WMC is collected on a specific house. BCEGS ratings are a proxy for the construction practices within a given territory, whereas the inspections associated with WMC are a structure-specific observation of the actual physical features on the property. So, in essence, the specific observation of the physical state should overrule the proxy variable associated with the BCEGS rating. From a theoretical view point, the practice of using the larger of the BCEGS or the WMC can essentially mask a weaker structure from being charged an appropriate premium. RMS has not evaluated how often this may occur in the industry. But from a purely logical standpoint, RMS recommends that the FL statute be modified such that insurers are not forced to use both factors at the same time. It is perfectly reasonable to use the BCEGS in the absence of WMC information, but the practice of tempering BCEGS or taking the larger of the two is logically inconsistent.

SECTION 4: IMPACT OF WMC ON TYPICAL INSURANCE COMPANIES

Overall Methodology

As summarized in Section 1, primary insurance companies are required to include the full value of the WMCs in their rating algorithms, triggering comments and concerns about the rates charged and the financial impacts on primary writers. Insurance companies have expressed concerns that the mandated WMC tables are adversely affecting the premium levels. In this report RMS tests a theory that the current market may be undergoing a re-classification of risk as wind inspections are completed and reported to the insurance companies instead of the intended hardening of the building stock. The degree to which re-classification or actual hardening is occurring has been hard to determine from the asymmetric data collected by insurance companies as described in Section 3.

The analysis here is designed to test the degree to which the application of WMC factors affects premium levels, and insurance company costs. Our approach here is a thought experiment; if the assumption is that only re-classification is taking place in the market, then, holding all else equal, it is possible to measure what happens to premiums and costs as WMC factors are applied to various segments of the population. The degree to which the results fit the available observations provides a basis for determining the degree to which hardening versus re-classification is occurring.

The framework for this "experiment" is the creation of a hypothetical insurance company that mimics the behavior of the entire industry. This analysis focuses on homeowners (HO3) policies that include wind coverage written in the voluntary insurance market. This means that we did not include information from Citizens or any renters, condominium owners, commercial residential or commercial non-residential policies.

The steps in our analysis include the following:

1. Analyze public data for trends in reported premium in the last 3 years since the implementation of the fully indicated WMC tables recommended in form OIR-B1-1699 [104].
2. Create the analysis framework
    a. A hypothetical insurance company portfolio, using a simplified premium rating algorithm that produces a snapshot of relevant information as it looked before mitigation credits were applied. The premium dollar is allocated into components covering expected losses and expenses, including reinsurance.
    b. Analysis of the order in which voluntary inspections are conducted in the market given the economic motivation of the homeowners.
3. Assess changes to premiums and costs as WMC factors are applied to the company portfolio, and inspections begin to occur.
4. Compare to the observations in Step 1.
5. Explore alternative outcomes with revised implementations of WMC tables and rating plans.

A key element to this analysis is knowledge of the WMC attributes for the entire population of buildings in the portfolio. RMS has created a unique model of the WMC attributes for the entire population and can measure how asymmetric data can affect modeled loss costs, reinsurance costs, and premium income as Florida moves from a state where no wind inspections have been completed to a state where a 100% inspection level is present. Note that most insurance companies do not have complete WMC information on all their properties, which is a barrier to being able to demonstrate the degree to which reclassification is occurring in their individual portfolios.

Observed Trends in Premiums

There are several sources of publicly reported premium data available. The source used in this study was the QUASR system, which provides quarterly snapshots of policies in force as reported by all companies. Information is provided by company at a county level and separate reports can be generated for policies including wind and for those that do not cover wind. Charged premiums, insured values (limits), and policy counts at the county level are given.

RMS obtained four snapshots of QUASR data: 4th Quarter 2006, 4th quarter 2007, 2nd quarter 2008, and 2nd quarter 2009. Further details on the QUASR data are provided in Appendix B. Data from Citizens Property Insurance Corporation was removed from the analysis to create information that applies only to the market that voluntarily includes wind peril coverage.

Although WMC tables were implemented in 2003, the compressed version of the tables resulted in much smaller credits. For the purpose of this analysis, we assume that the amount of WMC information in the market at that time was relatively small and therefore can be neglected. Thus we assume that 2006 represents a stable point from which to measure the effect of the application of the fully indicated WMC factors, and thus will be referred to as the point in time "Pre-WMC."

The graphs below show results of RMS' analysis of the change in charged premium rates (sum of charged premiums divided by insured values) reported to QUASR. Figure 12 shows changes in average premium rates by company from 12/31/2006 to 6/30/2009, as well as the statewide average. There is a wide range of change from company to company in both direction and magnitude. However, the statewide average shows a decrease of approximately 20% over this time period.

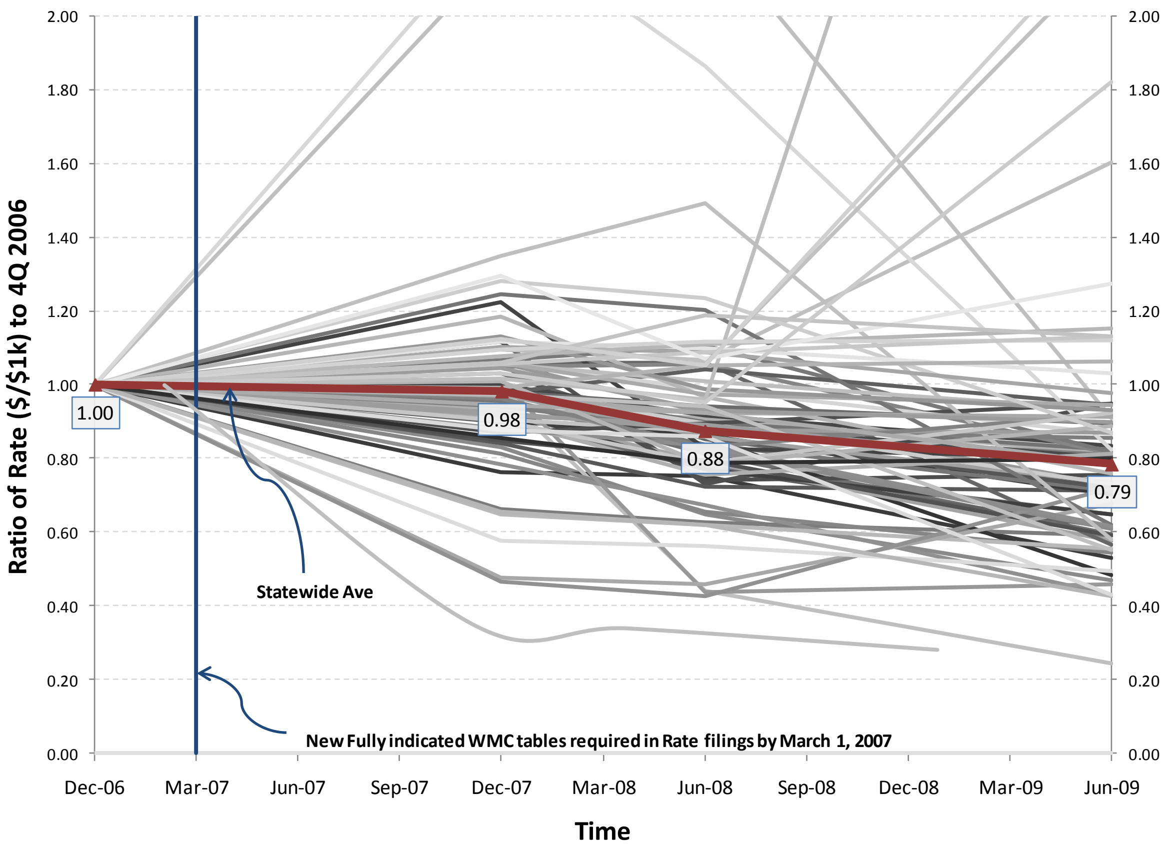


Figure 12: Change in average premium for two and half years for companies reported in OIR's QUASR system as ratios to fourth quarter of 2006. The bold red line represents the statewide average; individual companies are shown as various shades of grey lines.

It is interesting to note that there appears to be a period of stability from Dec-2006 until Dec-2007, which may be related to the fact that new rate filings with the fully indicated WMC tables were required by March 1, 2007 and several months must elapse for insurance companies to put these rating algorithms into practice. In the next six months following Dec-2007, the statewide average dropped by about 10% followed by another drop of 10% in the next year. Thus, the overall change appears to be approximately 20% overall since the inception of the fully indicated WMC table in 2007.

Note, too, that a handful of companies show *increases* in premium rate charged over this time period, while the majority show decreases. Obviously, there are many additional factors that contributed to the QUASR premium change. Rate changes due to factors other than mitigation credit implementation, such as effects of HB1A in 2007, coverage changes, geographic shifts, and policyholder buying behavior are among the factors that influence charged premium. Since information to adjust the older rate level in any meaningful way without introducing bias is not available, the unadjusted level is the best, although imperfect, observation of the trend in premiums. Note this graph shows the change in premium rates in force, but does not show how the actual premiums or rates compare across companies.

In Figure 12, statewide average drop in premium rate is reported as 79% of pre-WMC values across the aggregate of all companies. Figure 13 shows the contributions to this overall result by county. The counties are divided in 3 regions, north, Central and South, and each of those regions subdivided into Coastal and Inland counties. The Central region, with a few exceptions, shows the least change. All Southern Coastal counties, except Lee and Martin, have changes that exceed the 20% statewide average. Note that the change shown for Monroe County reflects aberrations related to QUASR data reporting[17]. These pieces of information were appropriately adjusted throughout the analyses, but appear here as they did in the raw information.

[17] Based on personal communications with the OIR, there are possibilities for irregular data to be contained in QUASR as the system has changed over time, and contains information voluntarily reported by insurance companies that is not subject to rigorous validation.

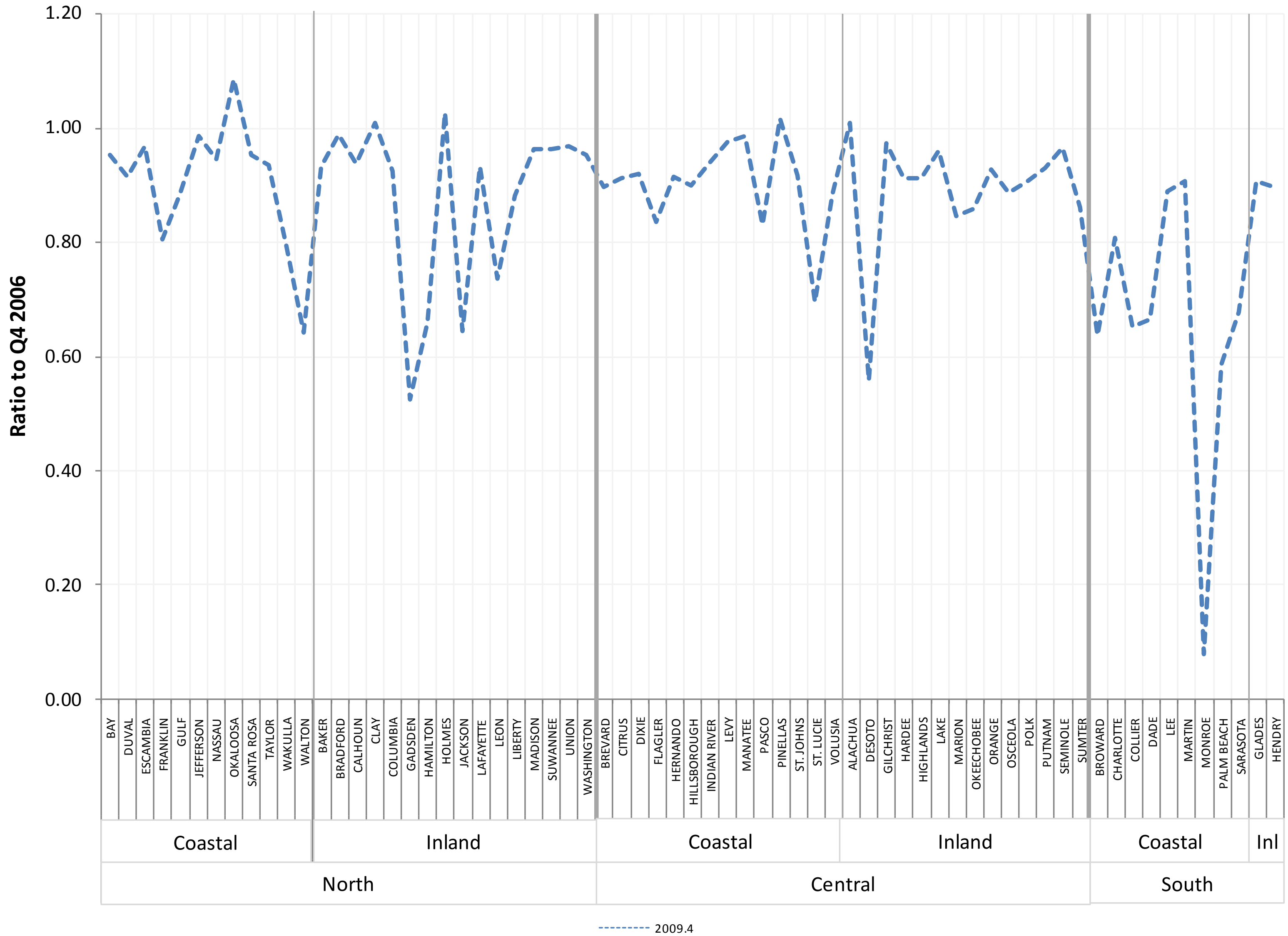


Figure 13: Ratio of average premium rate per county for second quarter 2009 versus fourth quarter 2006. Florida's 67 counties grouped into 6 regions: Northern Coastal, Northern Inland, Central Coastal, Central Inland, Southern Coastal and Southern Inland. The groupings are those used by the FCHLPM in its submission requirements.

Creation of Hypothetical Insurance Company Information

The hypothetical company created for this analysis could have been any size. Making it equivalent in size and scope to the entire insured single family residential population has the advantage that comparisons to benchmarks for size, pricing and trends can be made. The approach taken is to create an entity that approximates, but may not exactly reproduce, the details of the industry in the aggregate. The goal is to have a reasonable starting point to which factors like the WMC inspection data can be introduced, and calculations in the changes to various metrics can be made.

In order to create our hypothetical company, we need information on the portfolio (the characteristics of who is being insured), information on a premium rating algorithm (how much they are being charged), and information on costs (what expenses are). The data sources used for these components are shown in Table 10 and Figure 14, depending on the type of information needed. This company is being created, and assumed to exist at the end of 2006.

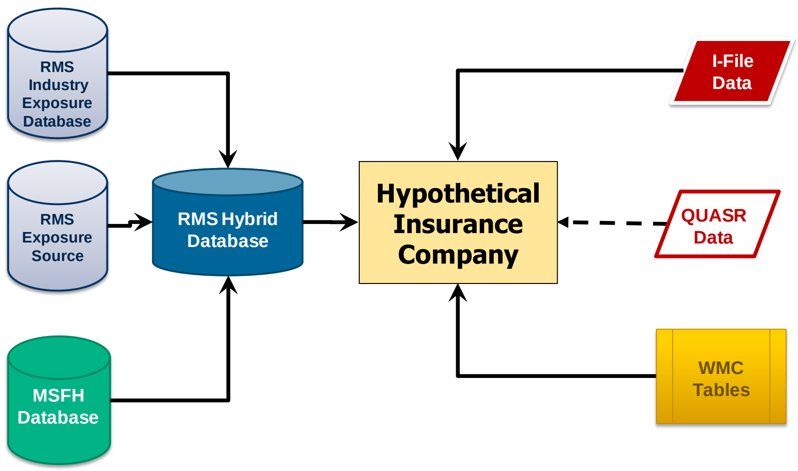


Figure 14: Information used in creating hypothetical Insurance Company for analysis

Table 10: Data sources relied upon to create hypothetical insurance company

Information	Source
Portfolio information	
Number of policies	Hybrid Database
Total Insured Value (Exposure)	Hybrid Database
Deductible	Hybrid Database
Primary Rating Characteristics	Hybrid Database
Secondary (Mitigation) Characteristics	Hybrid Database
Premium Rating Algorithm	
Base Premium Rate	I-File RCS Rating Examples
Wind Percentage of Premium	I-File RCS Rating Examples
WMC Factors	OIR Form (OIR-B1-1699
Costs	
Premium Dollar Allocation	I-File information from company rate filings

The various information sections (from I-File and the hybrid data base) were matched to create a realistic group of policies. Since the data is not all at the same level of detail, time or completeness, judgment was used as necessary to complete the profile. We reviewed alternative sources of similar data extensively in order to make the best use of the information available and to confirm that our selections and assumptions were appropriate.

Portfolio Information

Almost all of the information on the buildings in our portfolio was taken from RMS' hybrid database: The hybrid database contains a combination of detailed, location-specific level information and aggregated ZIP Code classes that describe all residential insured properties in the state. It contains policy terms such as limits and deductibles and also structure characteristics, such as construction and occupancy. The hybrid database is a compilation of information from RMS industry databases and in-house research into other wind rating attributes, resulting in a unique geographic distribution of wind mitigation characteristics. The assumption is made that these characteristics are applicable to our starting point – Pre WMC –– and remain constant through the analyses. A description of how the hybrid database was developed is in Appendix B.

The hybrid data base allows an analysis of the impact of the WMC implementation on a ZIP Code level. In addition, each ZIP reflects the distribution of characteristics within the ZIP Code. This means that each rating characteristic (such as construction) and each mitigation feature are analyzed at a very detailed level. While the premium and rate information we have is not broken down any further than by county, having the descriptors at a more granular level provides a way to evaluate the ranges existing within the county level aggregated information.

Premium Rating Algorithm

Insurance premiums are designed to cover the losses and expenses expected to be financed during the period of time that the premiums will be charged. Although there are many ways to create a premium rating algorithm, our model relied on a relatively simple formulation.

$Premium = Rate * Coverage * (1 - Wind\% \ * WMC)$,

Which requires 4 components:

- A rate per $1,000 of coverage in each territory (Rate)
- A percentage of premium for wind coverage in each territory (%Wind)
- A Wind Mitigation Credit table (WMC) which is a function of the WMC attributes for each building
- Coverage which is the total insurance value from the hybrid database for each building.

Base Rates

The rate being described is used as the "base rate" for the purpose of this analysis. The exposure unit can be considered to be $1,000 of total insured value.

Rating territories for this exercise are counties. Although most insurance companies use finer geographic resolution for rating territories, the simplification for this exercise has the advantage of lining up with the I-File information used to establish our base rates.

I-File information from the rating examples of the top twenty insurance companies was used to calculate rates and wind coverage percentages for each county, as well as the split into wind and non-wind portions. These rates were then assigned to the policies in the hybrid data base. Since the hybrid database has insured values at a detailed geographic level, the hypothetical geographic distribution of policies is representative of the true distribution. There are three sets of rated premiums in I-File: one for new construction, one for pre-2001 construction without any mitigation features and one for pre-2001 construction with “maximum mitigation.” The pre-2001 construction without any mitigation features was used to reflect the 0% fidelity level, which is our starting point in 2006. We weighted the rates by company market share within each county and multiplied our rate per $1,000 of total insured value times the total insured values for each county from the hybrid database.

The I-File risk descriptions and an example of the information provided in the I-File examples are given in Appendix B.

Wind Portion of Rate

Besides hurricane, there are other wind-caused losses in the state. Since the mitigation characteristics also apply to non-hurricane wind damage, the wind/non-wind split accurately reflects the credits. Adjustments have been made throughout the analysis for this purpose. The I-File rating examples give hurricane and non-hurricane rates, which was used as the hurricane portion of the wind rate. The non-hurricane portion was incorporated by assuming an amount equal to 5.3% of non-catastrophic losses[18].

Wind Mitigation Credit Table

The Wind Mitigation Credits used are those in OIR form OIR-B1-1699, which are the fully indicated relativities from the 2002 ARA study, expressed as credits normalized to the weakest building.

Estimating Expenses, Reinsurance Costs, and Expected losses

Insurance premiums are designed to cover all the expenses and expected losses for a given period of coverage. The application of WMC information to the portfolio will have varying impacts on each of the different types of expenses, and expected loss levels for our hypothetical company. Thus, the analysis requires an estimate of the components that make up the total premium. For this analysis, we follow an approach that breaks the total premiums calculated from the premium rating algorithm for each location in the hybrid database, down into subcomponents which can then be individually assessed for their sensitivity to the application of WMC information. The components considered in this analysis, shown in Figure 15 , include fixed expenses, variable expenses, net reinsurance costs, loss adjustment expenses, non-wind related losses, and “other wind” related losses. “Other wind” related losses are associated with non-hurricane wind events like tornados and winter storms.

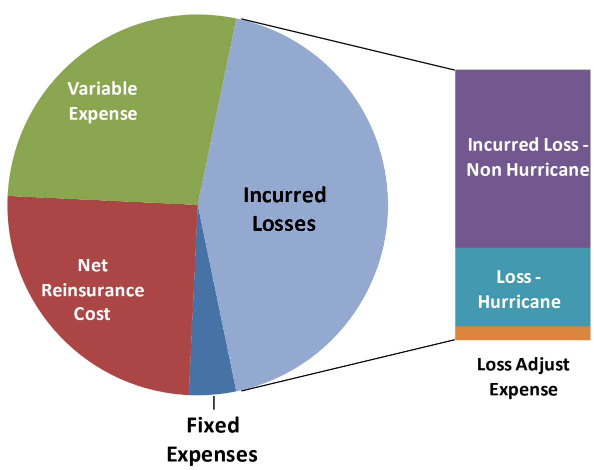


Figure 15: Components of total premium

[18] ISO excess wind. Circular as found in [43]

The I-File system contains information provided by primary companies related to their rate filings, which including allocation of the premium dollar into categories, rating examples, and additional details about their books of business. Using I-File information, total premium was categorized into the expenses and expected losses the amount charged is meant to cover. RMS reviewed the rate filings of the top 15 insurance companies and selected representative allocation percentages shown in Table 11 below. The rate filings from which we reviewed premium dollar allocations are listed in Appendix B.

Expenses can be fixed or variable, depending on whether or not they change with the size of the premium. It is logical to assume that variable expenses can be divided into the hurricane and non-hurricane pieces in the same proportion as the expected losses. Variable expenses are assumed to be 27.5% of the premium for our hypothetical company for every policy.

Fixed expenses do not vary with the size of the premium, and so there is no reason for them to change with the application of the WMC. In this analysis, the total fixed expenses, other than net reinsurance costs, are assumed to be 4% of the total portfolio premium as shown in Table 11. We saw in Section 3 that applying WMCs to some or all of the fixed expense can result in more credit being given than was seen when the basis of the credit application did not include fixed expenses.

Reinsurance is a special type of expense. Reinsurance is purchased mainly (and often exclusively) to cover catastrophic hurricane or wind loss, and protect a company from financial ruin should a large event occur. Rate filings in Florida allow insurance companies to include the net cost of reinsurance in their premiums which is defined as the total reinsurance premium paid from the primary insurance company to the reinsurance company minus the expected (average) recovery for the coverage. This amount is often treated as a fixed expense and in our hypothetical company is equal to 25% of the total premium or the portfolio.

Expected non-wind losses and the associated LAE are not impacted by the WMCs and remain constant throughout the study. The amount of the premium associated with non-wind losses is estimated as the complement of the wind percentage developed for the premium rating algorithm above, and varies by county.

Expected wind losses and the associated loss adjustment expense (LAE) form the core of our interest. When mitigation credits are applied, they should impact these losses, and any savings from home hardening should be reflected in the premium needed to recover these reduced losses. Since mitigation features applicable to hurricane act similarly on expected wind losses from events other than hurricane, we include “other wind” loss and expense information with hurricane loss and expense information in the “wind” category.

Table 11: Assumed distribution of costs as percent of premium for hypothetical insurance company.

Category	Fixed Expenses	Variable Expenses	Total
Commissions	0.0%	17.0%	17.0%
Other Acquisition	1.5%	2.5%	4.0%
General	2.5%	2.5%	5.0%
Premium Taxes	0.0%	1.8%	1.8%
Misc. Licenses & Fees	0.0%	0.0%	0.0%
Profit & Contingency	0.0%	3.7%	3.7%
Contingent Commissions	0.0%	0.0%	0.0%
Non-FHCF Reins. Cost	25.0%	0.0%	25.0%
FHCF Reins. Cost	0.0%	0.0%	0.0%
Total	29.0%	27.5%	56.5%

Data Fidelity Levels

Fidelity Order

In order to study how WMC information affects the total calculated premium, this analysis requires a model of the order in which wind inspections are taking place, which in this study we refer to as the “fidelity order.” Given that the wind inspections have occurred on a voluntary basis, we can assume that the motivation for a homeowner to participate in the inspection process is largely motivated by financial gain. Thus, for this exercise, RMS has created an inspection order that is based on comparing the potential homeowner premium savings resulting from an inspection against the cost of the inspection ($150). This calculation is completed for each building and then all buildings are ranked in descending order of net savings.

The portfolio is divided into a series of slices based on this net savings order to create 7 distinct data fidelity levels ranging from 0% fidelity to 100% fidelity, as shown in Figure 16.

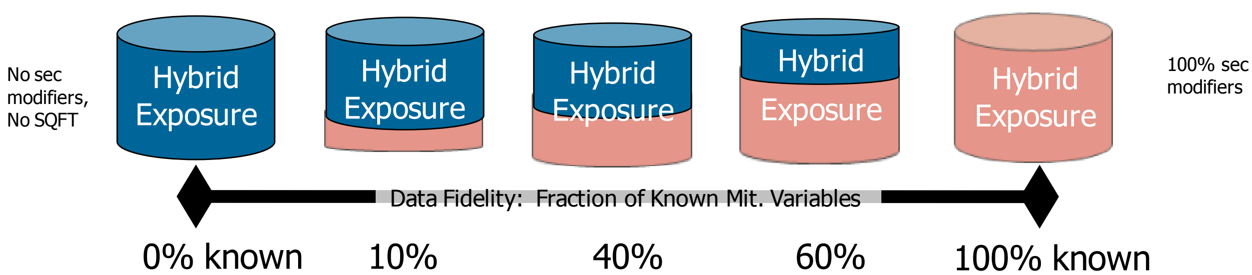


Figure 16: Representation of fidelity order in hybrid database

Establishing the Statewide Data Fidelity Level

Data does not exist to determine the fidelity level with certainty. The *Windstorm Mitigation Discount Report* also noted a lack of information in their report, and suggested a statewide data collection system.

The first observation of the statewide fidelity level can be inferred from the My Safe Florida Home Program. This program inspected approximately 10% of the population in total between 2006 and 2009. We don’t know how many other private inspections have been completed since the end of the program, but this certainly suggests that the level must be at least 10%, assuming that each homeowner that participated in the program sent their information on to their insurance company.

The second and best observation comes from the yearly FHCF data call. Since 2007, the FHCF data call has included some variables that are related to mitigation. The data that has been collected is of varying levels of usefulness when comparing to the OIR relativity factors. For example, the FHCF data call from last year, summarized in the 2009 rate making report [28], shows distributions for a variable called “Florida Building Code indicator” that is nearly identical to the year built distribution above. This variable adds no additional data to the specification of risk levels, as it appears that it is largely determined by year of construction. The roof deck attachment variable and the roof-wall collection variable do not align with either the OIR relativity table variables, or the UMVI form, which adds complexity to measuring the data fidelity level quite difficult. The data call also mixes the unknown characteristic with the typical or default characteristic. For example, for the roof shape, gable roofs which are the most common roof shape, are included in the same class as “unknown” which effectively masks the degree to which actual inspection data is being reported in the data call.

However, even with these limitations, the FHCF data is at least a statewide, verified data call, and does provide the best estimate of the statewide data fidelity level at this time. Table 12 shows the percentage of residential units that reported opening protection, roof shape, roof anchor details. Note that the percentage of anchor bolts is 10%, and the percentage of hip roofs is 20% and the percentage of opening protection that is not none or unknown is about 11% in the 2009 column. Thus, this information suggests a data fidelity level of approximately 20%.

Table 12: Reported WMC-like attributes from the 2009 and 2008 FHCF ratemaking reports (see Appendix B for full table)

STRUCTURE FEATURE	Percent of Units 2008	Percent of Units 2009
Opening Protection		
None or Unknown	90.13%	88.27%
Basic Shutters	2.06%	2.36%
Hurricane or Engineered Shutters or FBC-Equivalent	7.82%	9.37%
TOTAL	100.0%	100.00%
Roof Shape		
Hip, Mansard, or Pyramid	15.09%	20.06%
Gable, Other, or Unknown	84.91%	79.94%
TOTAL	100.0%	100.0%
Roof-Wall Connection		
Anchor Bolts, Hurricane Ties, Clips, Single Wraps, Double Wraps or Structurally Connected	4.23%	10.83%
Nail, Toe Nails, crews, Gravity, Friction, Adhesive Epoxy, Other, or Unknown	95.77%	89.17%
TOTAL	100.0%	100.0%

To improve the quality of the mitigation data stream, RMS recommends the following changes to ongoing efforts of the Florida Hurricane Catastrophe Fund (FHCF) to collect additional wind rating variables through its yearly data call[19], so that:

- Reported variables align with the variables currently used in the Uniform Mitigation Verification Inspection (OIR-1802) form and, therefore, the WMC variables;
- Other key rating factors, such as number of stories and square footage, and roof slope, are collected;
- The unknown state of a variable is collected separately (i.e., uninspected), so that the industry can measure the progression of data collection over time. For example, rather than lumping “gable” and “unknown” together, the data call must require companies to identify these separately. This is a key issue that will make it easier to measure the degree to which reclassification versus hardening is occurring within the state.

Another benchmark can be seen in the summary of the Citizens Property Insurance Corporation data in Appendix B where the fraction of the HO3 portfolio for which wind mitigation credits have been submitted are reported is between 61% and 74%. This would suggest that the market is well along the data fidelity scale – however, it is not clear if data has been collected and reported on all the attributes of the UMVI form, or if only the roof shape is being reported. If it is the latter, then this fidelity percentage might be an over estimate. Another limitation from this observation is that the Citizens policyholders tend to be concentrated in the high hazard areas in south Florida and along the coast. If our assumption regarding the motivation behind the inspection order is true, it would be natural to see a higher concentration of inspections in this data set.

[19] Each authorized insurance company writing Covered Policies in the state of Florida must submit its total covered property exposure each year; this information is collected by Paragon Strategic Solutions Inc. and is available at http://fhcf.paragonbenfield.com/.

Therefore, based on these pieces of information, RMS estimates that the statewide fidelity level is between 20% and 40% of the total residential population at this time.

Measuring the Impact of WMC

Financial impacts on a company can be focused on three areas: (1) Premiums (money coming in), (2) expected losses, expenses and reinsurance purchase (money going out), and (3) the interaction between these two. This analysis evaluates the degree to which these various components change with the application of WMC to our hypothetical portfolio. As identified in the previous section, the only components that are likely to change with WMC application are the total premium levels, the reinsurance costs, and the expected hurricane losses. The cumulative changes will be summed together in the equivalent of a rate filing indication sheet at the end of this section. First each component of the rate filing indications are discussed and examined separately.

Change in Total Premium

Using the premium rating algorithm, RMS has calculated the change in total premium with and without WMC information – i.e., before and after a wind inspection. With the inspection order, defined above, one can now establish a series of slices of the portfolio which get inspected first, second, etc. By applying the WMC information in this order, the change in the total premium can be plotted as inspections proceed, as shown in Figure 17. Note that this figure illustrates the change as inspections occur – not a function of time. However, if we use the estimate of 20% fidelity from above, then this figure suggests that drops in the premium level of 20% would be observed under the analysis conditions.

The calculated premiums were compared to QUASR data (statewide change from Figure 12). The current WMC line crosses the QUASR observation at roughly 20% fidelity. The fact that the estimated drop in premium at our estimated fidelity level of 20% matches the observed drop in premium rates is indicative that the change in premiums observed in the QUASR data is substantially explained by the re-classification associated with the population. Remember, that the analysis here has been conducted assuming that no further hardening activities have taken place since early 2007.

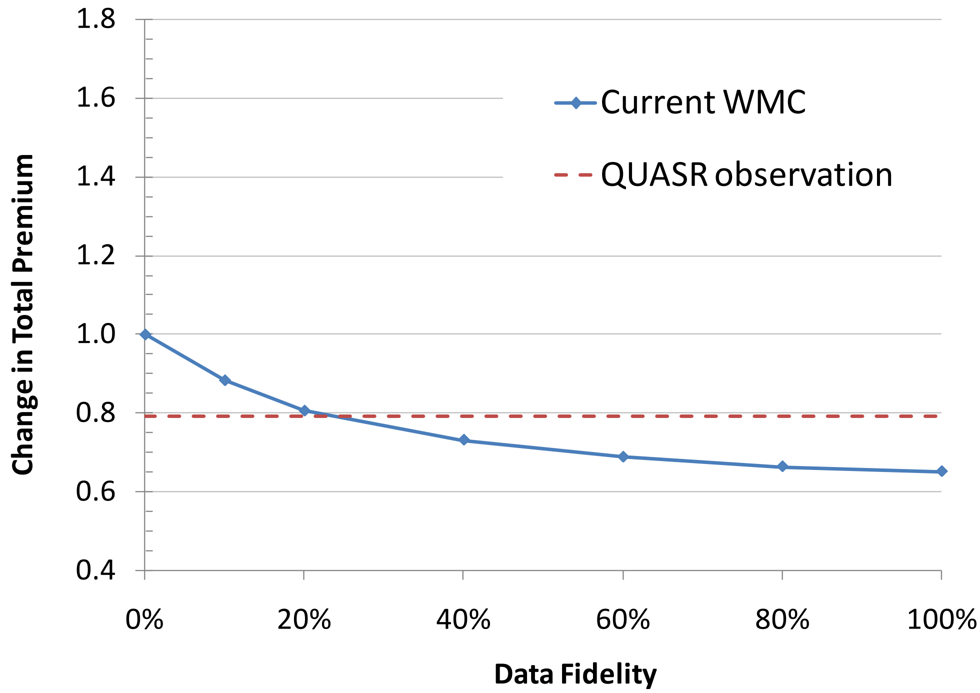


Figure 17: Calculated drop in total portfolio premium for various data fidelity states versus observed drop in QUASR data.

One must be cautious about concluding that reclassification is the only activity occurring. At the statewide level, we have a decent match, but when we examine the count level metrics, then there is less agreement between our model and the observations. The maps in Figure 18 show that there is broad agreement between the observation and our model of our hypothetical company. Note that the southernmost part of the state has seen the most change and is also the area most likely to benefit from reclassification. Figure 19 plots the same information in graphical form that compares the QUASR observations with calculated drops for the 20% and 40% fidelity cases – both cases are shown to determine whether our fidelity levels envelop the observations in each county. Notice that the drops in south Florida are well correlated with the QUASAR information. There is also broad agreement between the model results in the southern coastal counties and the estimated 30% drop in the Citizens portfolio premiums (see Appendix B – HO3 of PR-M).

The model does not illustrate much of a drop in the inland counties which could indicate that our economic model of the inspection order is too simplistic and the efforts of private inspection firms or the MSFH program to promote inspections is higher than what our inspection order model suggests. Alternatively, as mentioned earlier, there are also other factors that may be affect rate changes that are not reflected in this analysis, and would have affects on the inland counties that are different than the model. Overall though, because our calculations pick up statewide trends and mimic the pattern on a county basis, there is enough evidence to suggest that the current application of WMC factors is a significant contributing factor to the reported premium degradation.

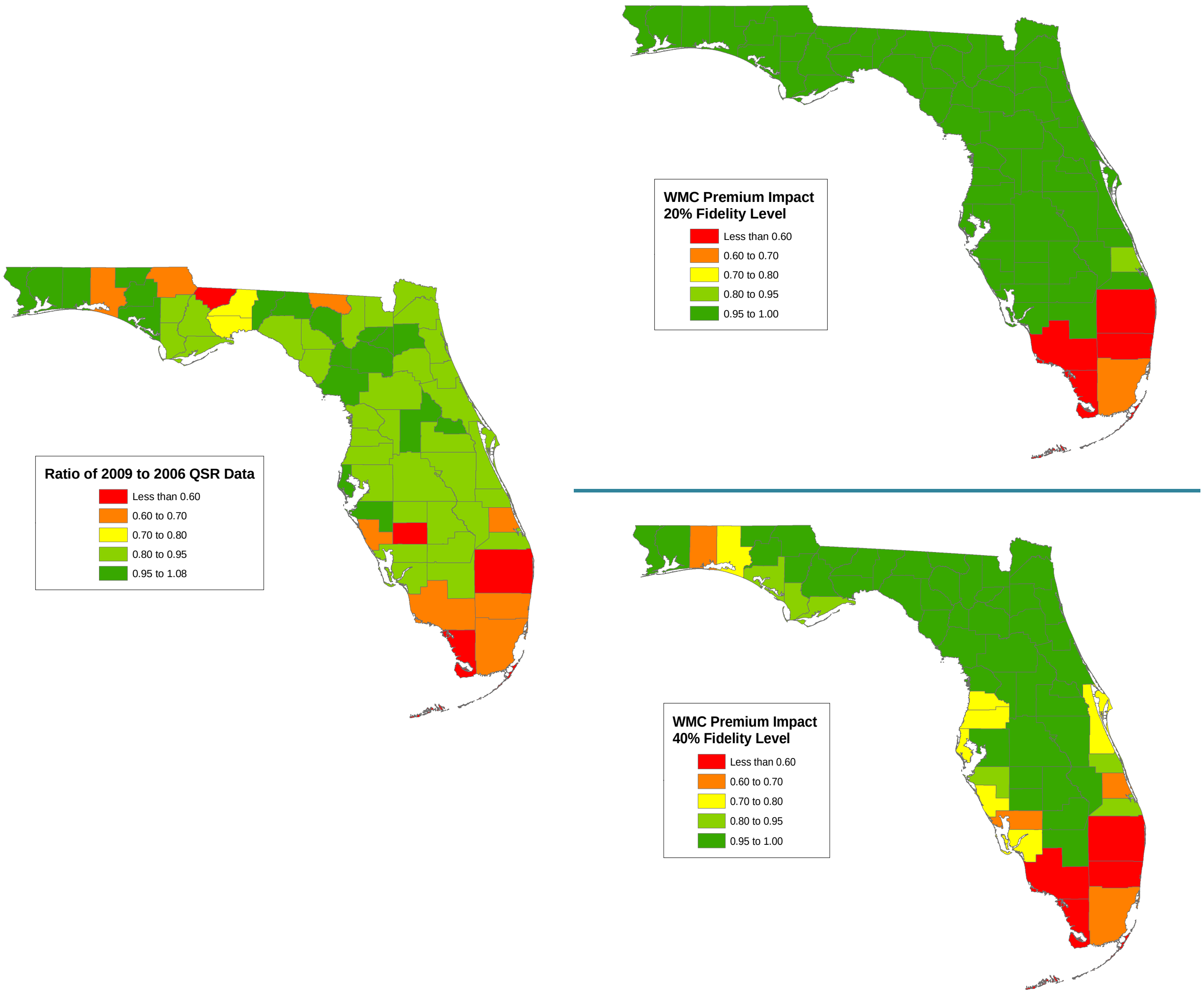


Figure 18: Maps comparing the Observed drop in industry premium (left) versus calculated drop in our hypothetical company (right) for the 20% and 40% fidelity level.

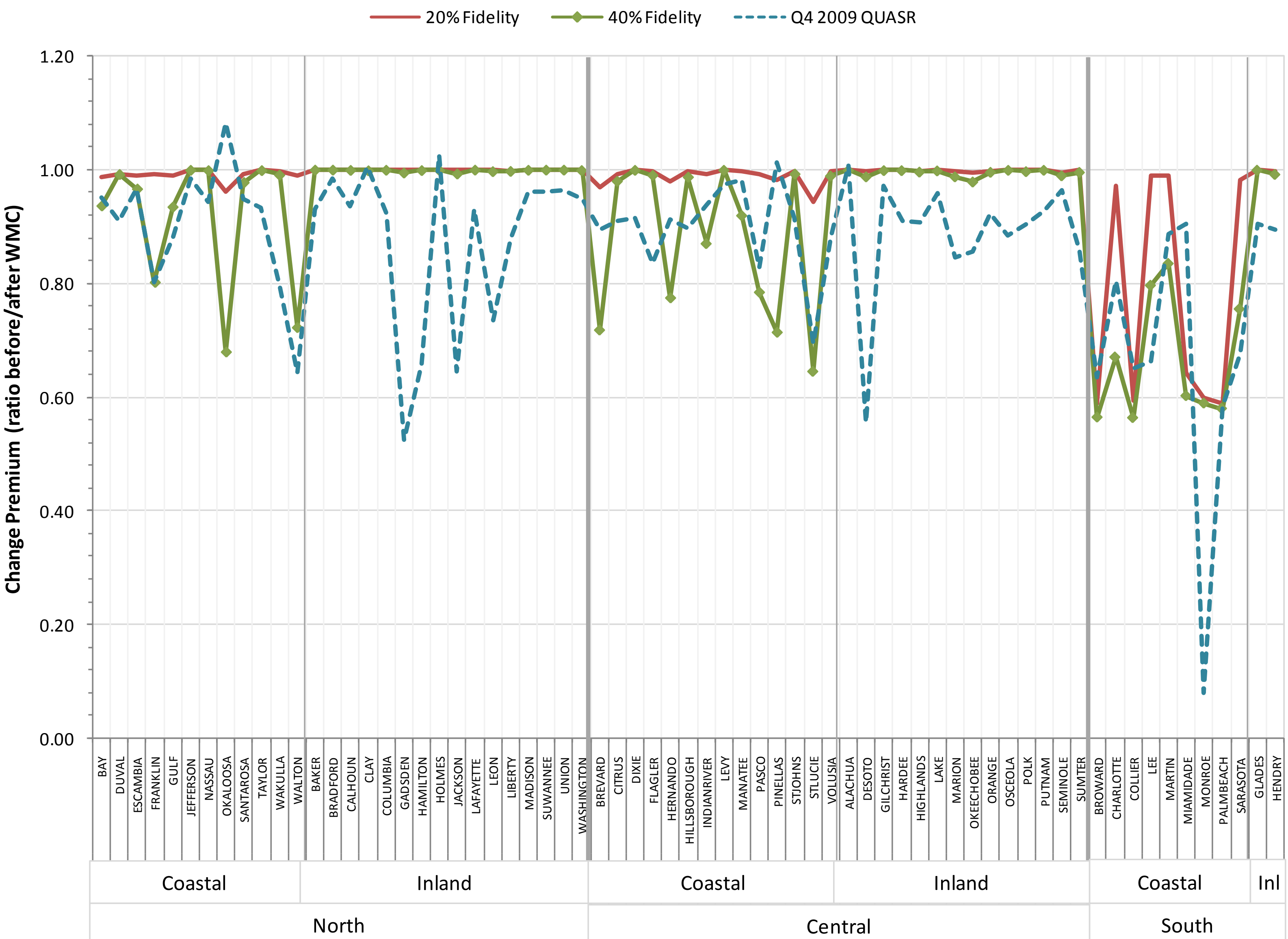


Figure 19: Comparison of drop in average premium from Q4 2006 to Q2 2009 in QUSAR data versus calculated drop from 20% and 40% fidelity levels.

Change in Reinsurance Costs

Reinsurance is an integral part of the Florida property insurance market; simplistically, reinsurers provide insurance to insurance companies. The Florida Hurricane Catastrophe Fund ("FHCF" or "Cat Fund") is a quasi-state entity that provides significant, below-market priced reinsurance capacity to admitted property insurers for their Florida exposure. Private market reinsurance provides coverage in addition to the mandatory (and optional) FHCF coverage layers – allowing Florida hurricane exposure to be efficiently spread around the globe.

Property catastrophe reinsurance pricing in the private market is fluid, and is impacted by general economic conditions (e.g., losses or gains in investment portfolios), underwriting results (i.e., underwriting profits are higher without hurricane losses, which leads to increased surplus levels/capacity of private market reinsurers; and, the converse is true – high levels of hurricane loss payouts reduces reinsurer surplus levels/capacity), and a number of other factors. For example, it is estimated that private reinsurers stock buy-backs exceeded $18 billion in 2007 and 2008, with a major reason being that the FHCF TICL layer reduced demand for private market reinsurance, and reinsurers were left with under-deployed capital.

Historically, property catastrophe reinsurance pricing year-over-year ("YOY") changes tend to be in the single to low-double digits range – up or down. The recent historical aberration to this was after the 2004 and 2005 hurricane seasons where private market reinsurance pricing increased by as much as 100% YOY, with Guy Carpenter (a leading reinsurance broker) noting that the average YOY increase was +45% for the higher layers, +29% for the middle layers, and +22% for the lower levels. Also, it is very important to note that reinsurers underwrite the insurance companies they are providing capacity for in a fashion similar to an insurance company underwriting an individual policy. This fact can impact pricing from one company to another by as much as ten percent (10%) or more.

RMS conducted a series of short 1.5 hour surveys with some key contacts in the reinsurance industry that could provide more color around how primary-reinsurance mechanism currently deals with mitigation information, and what could be improved. RMS surveyed leading reinsurance brokers and reinsurers with significant market share in Florida property catastrophe reinsurance, with the objective of gathering qualitative information on the reinsurance market's views and handling of mitigation credits in their analysis of Florida property insurance exposure AND this market's handling of credits in pricing reinsurance capacity in Florida. The survey focused on the following key topics:

- Data Completeness
- Data Quality
- Use of Data in Modeling
- Reinsurance Pricing
- Mitigation Credits

Our survey concluded that reinsurers have some concern about the magnitude of the credit amounts that primary insurers are required to give in Florida. There is a tendency for reinsurers to discount or mute the impact of the WMC information when used in the catastrophe modeling. Thus, when WMC information creates a reduction of 20% in the expected loss, the survey participants indicated that this will not result in a 20% reduction in reinsurance costs. The reasons for this discounting were attributed to a number of other factors that impact reinsurance pricing and capacity. These other factors can be technical (e.g., cat model and financial model analyses) and non-technical (e.g., company historical results, strength of management team, catastrophe response plan and capabilities, etc.) and essentially minimize the effect that mitigation credits may provide to a primary insurer.

Additionally, our survey results indicated that reinsurers want to see more evidence to support the magnitude of mitigation credits currently reflected in the hurricane catastrophe models. Further, there is a strong skepticism about the application of credits for individual mitigation techniques versus a mitigation program designed around the level of integrity of the overall building envelope (e.g., many are concerned about the “weakest link” concept – there is a difficulty in trying to determine actual expected loss when a home has hurricane shutters for their windows, but the roof condition is poor and garage door is not reinforced.)

The information presented in Section 2 addresses some of those concerns expressed by the reinsurance community regarding faith in the magnitude of the wind mitigation relativities and the treatment of the weakest link problem. However more work could be done to promote the science behind the relativities. We did note, however, that very few of the participants identified asymmetric data as an issue. As described in the next section, RMS perceives this issue to be a critical part of understanding how WMC do or don’t affect expected hurricane losses and reinsurance costs.

Modeling change in Expected Losses and Reinsurance Costs with different Data Fidelity Levels

Expected hurricane losses in Florida rate filings are developed directly from catastrophe model output from a model reviewed and approved by the FCHLPM. There is an expectation that the modeled hurricane loss would change with the application of WMC information. For an individual policyholder who has reported mitigation feature information, this is likely to mean a lower expected loss, especially if the policyholders who report have better than average homes (on a wind resistance scale).

However, under the assumption of our hypothetical company analysis that the inspection activity related to WMCs is largely resulting in reclassification and not hardening, it is possible that the portfolio level risk level (the aggregate of all homes) reported from catastrophe models should not change under these conditions. Figure 20 below shows why this happens using the roof shape variable as an example. The three columns in the figure each represent a list of properties in a portfolio. Before any mitigation features are reported (column A), each location is modeled with “unknown” attributes for roof shape. The catastrophe model uses an “unknown” damage curve which implicitly uses a distribution of gable roofs and hip roofs, in this example. In reality the portfolio is actually made up of a combination of homes with hip roofs and those with gable roofs (Column B). The hip roofs have lower expected losses and the gable roofs have higher expected losses than the average. If you inspect all the homes in the portfolio, column B would be equivalent to Column A.

However, under asymmetric data collection, like the current situation for WMC information in Florida, the hip roof homes are more likely to report information, since they receive a credit under the current WMC tables, whereas the gable roofs do not. Thus, many companies now have portfolio data sets that look like Column C – specific information on the hip roofs, but unknown information on the other roofs. The characteristics of the unknown locations are now more likely to be gable than hip since we’ve identified almost all the hip roofs in our inspection process. At this point in time, catastrophe models do not have a dynamic way to update the distribution of characteristics for the unknown case, and the model estimates for the unknown locations in Column C continue to assume the same percentage of hip roofs as in Column A. If the data is highly asymmetric, then there is a very real possibility that Column C would underestimate the aggregate portfolio loss levels.

There are only two alternatives to deal with this situation – the easiest approach is to simply ignore the new WMC information and model the portfolio as Column A. Alternatively, a company can attempt to characterize how the unknown case in Column C is different than Column A. This functionally means doing field inspections on homes that are not voluntarily reporting information. Even if this information is not used in the underwriting process, the data can be used to illustrate the degree to which re-classification is occurring in the portfolio. However, until the “unknown” in Column C can be can be accurately estimated, the original “unknown” in Column A remains the best estimate of the aggregate loss levels.

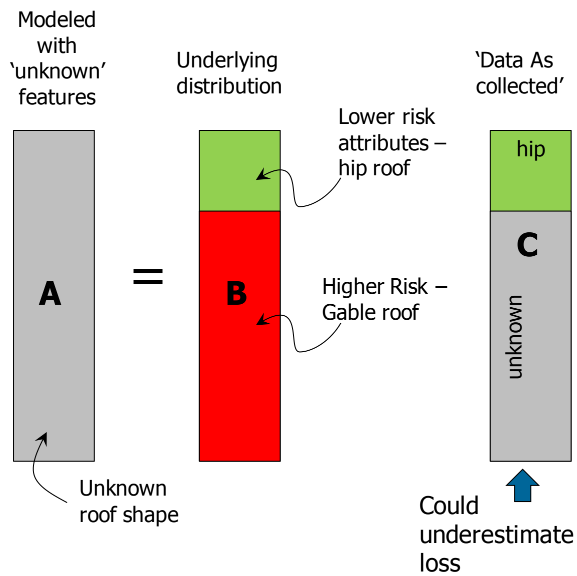


Figure 20: Illustration of how asymmetric data can result in underestimate of total portfolio risk.

Given the information we collected above, it is not surprising that reinsurers currently mute the mitigation signal. As mentioned above, the degree to which asymmetric data affects the portfolio losses depends on how skewed the reporting of new information can be. It is possible to quantify the possible under prediction in the current WMC system. In order to explore how the introduction of WMC information affects the catastrophe model results RMS constructed excess layers for both the Florida Hurricane Catastrophe Fund (FHCH) and the private reinsurance market for our hypothetical insurance company and followed the analysis process shown in Figure 21. A series of analyses for each fidelity level were conducted to demonstrate how the gross losses and various reinsurance layer losses change as the asymmetric data in the WMC inspection process is integrated into the modeling process.

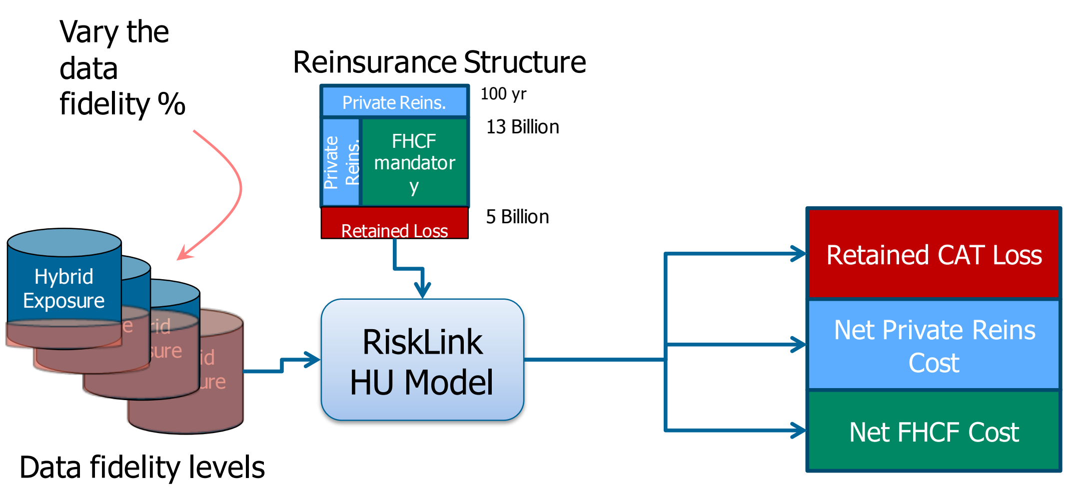


Figure 21: Process used to examine changes in model output as WMC information is introduced to our hypothetical company.

Selection of Reinsurance layers for modeling: In creating the reinsurance structure for our hypothetical insurance company, RMS referred to the 2009 FHCF ratemaking report [28] in order to reflect current conditions, and applied an estimate of the personal residential single family home FHCF layer to our portfolio. Two sets of private reinsurance contracts were added to reflect the decisions a company might make in purchasing risk transfer arrangements. These are shown in Figure 22. Private Reinsurance A provides 100% coverage that attaches on top of the FHCF and goes up to the 100 yr RP loss. Private Reinsurance B is designed to protect the company's FHCF co-pay and is 10% of the mandatory FHCF layer. Reinsurance B and the FHCF both inure to the benefit of Private Reinsurance A.

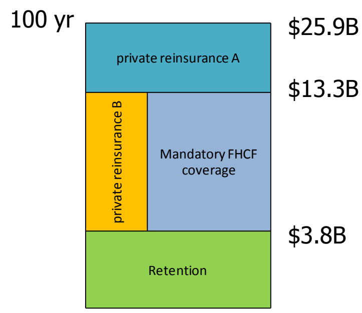


Figure 22: Assumed reinsurance structure for the hypothetical company.

The results of these simulations in Figure 23 show that all model loss results rebound after approximately 50% data fidelity as the worst of the portfolio begins to be incorporated into the analysis. The average layer loss for the reinsured layers follow the same pattern across fidelity levels as primary layers (retained loss) or the total aggregate loss (gross loss). Consistent with the example described in Figure 20, this exercise demonstrates how the apparent layer losses change when we assume that the current inspection activity is resulting in reclassification instead of hardening of structures. Ultimately when all 100% of the buildings are inspected the losses return to the same level as before WMC information is collected.

Thus, based on these analyses, RMS recommends that until data fidelity levels reach above 50%, or data is collected in a statistically rigorous manner, it is reasonable for portfolio modeling purposes (i.e., at the reinsurance level or for rate filings) to ignore the asymmetric WMC information This analysis indicates that the degree of under-reporting can be as high as 5-10%. It is also reasonable to conclude that at this point in time, net reinsurance costs in primary filings are unlikely to change with the initial collection of WMC information.

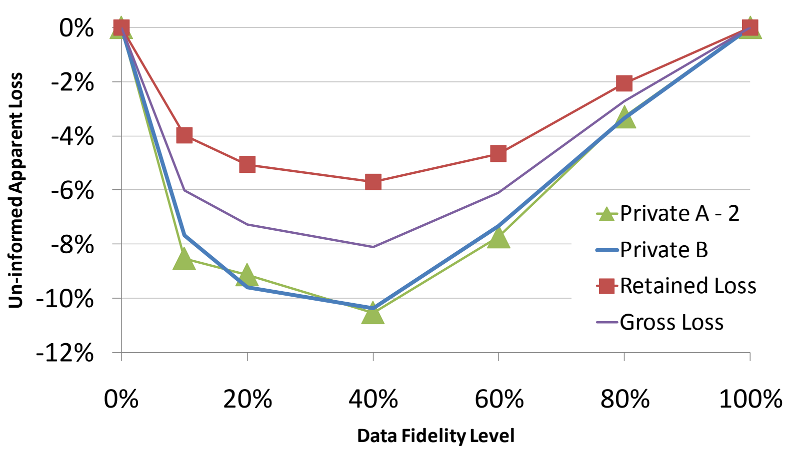


Figure 23: Modeled change in reinsurance losses for two private reinsurance layers and the FHCF mandatory layer versus the gross loss.

Florida Hurricane Catastrophe Fund

The Florida Hurricane Catastrophe Fund (FHCF), which provides low cost reinsurance coverage for a statutorily defined capacity, is in a unique position related to mitigation credits. Its current process assigns relative capacity based on each company's market share, as defined by its FHCF reimbursement premium. If the FHCF premium is reduced to reflect a company's market share is reduced, putting it at a disadvantage in its assigned portion of this advantageous coverage. To date, the FHCF has not incorporated the WMCs due to this approach to determining market share.

For the purposes of these analyses, FHCF net costs (that impact homeowners rates) are assumed to be zero and the impact on our rate indication in the next section will be zero.

Calculating the Net Impact: Realigning Rate Levels

The cumulative changes above are summed together to create our assessment of the net impact on our hypothetical company. As mentioned in Section 3, the misalignment of the base rate tables and the WMC tables in the industry can put significant pressure on the cash flow for an insurance company. Since there is, in theory, a mechanism for correcting this misalignment through the normal rate filing process, RMS presents the net impact in the same context as a traditional rate indication calculation.

These alignment needs were calculated using a traditional rate indication formula, the details of which are provided in Appendix C. It is important to keep in mind that these are not true rate indications that can be applied to any company or group of companies, and that the data, assumptions and methodology are not appropriate for this purpose. However, they do provide guidance regarding the direction of magnitude of the realignment that is necessary under these conditions.

Three main components enter into this evaluation: Premiums, expected losses including reinsurance, and expenses. The calculations are done on a total premium level, combining both wind and non-wind elements, in order to produce results meaningful to the bottom line of homeowner policies. Premiums have changed due to the implementation of the WMCs. Expected hurricane losses, and reinsurance costs should not change with re-classification.

The realignment needs for our hypothetical company were calculated for each data fidelity level under two different cases. The "Best Estimate Need" case is the preferred method showing no change in expected hurricane loss or reinsurance cost as discussed in the previous section. The case called "Un-Informed Apparent Need" quantifies how the realignment would be diluted from the true need if there is no recognition that partial use of asymmetric data will underestimate modeled loss levels. In other words, what happens to the realignment need if the analysis includes the 5-10% drop in modeled loss shown in Figure 23. Table 13 below shows premium adjustments needed to return the overall rate level to where it was pre-WMC implementation. The rated premiums assigned to the hybrid database were used at each fidelity level. To calculate these premium realignment needs, we used the rated premiums assigned to our hybrid data base as described previously. The original premium pre-WMC, is represented by the 0% fidelity level, while the other fidelity levels reflect the incremental application of the fully indicated WMCs to the total portfolio premium.

In the Best Estimate case in Table 13, the realignment need is equal to the premium change, which should be expected considering that the only impact from our assessment is the change in the charged premium levels per structure at each fidelity level. The interesting observation in this table is the degree to which the Un-Informed Apparent Need case is slightly smaller than the Best Estimate need. The different is between 1-2% at each fidelity level providing some indication of the danger of misusing asymmetric WMC data.

More importantly, the calculations indicate that according to our estimate the realignment need may be about 25% at today's fidelity level.

Table 13: Realignment needs for our hypothetical company to restore the balance between premium and costs

	Fidelity Level					
	0%	20%	40%	60%	80%	100%
Re-Alignment Need	0.0%	24.2%	36.9%	45.5%	50.9%	53.8%
Un-informed Apparent Need	0.0%	22.0%	33.9%	42.2%	47.8%	50.7%

Timing issues

Base rate offsets to realign premiums were initially not allowed, but currently these filings may be made directly by companies requesting adjustments. However, the requirements at this time to support the offset create delays and adds expense for the company. Until the offset filing is implemented and has been in effect for a full renewal cycle, a company is likely to be collecting less money for the same group of risks as it did before the application of the credits. We estimate that the delay is approximately 18 months, with a renewal cycle adding 12 months for complete realization of the correction. The data currently required to collect the information required to support a premium realignment is both expensive and time consuming to collect, which extends the elapsed time until the revenue can be received.

Inspection information on a substantial majority of homes is needed, and home inspections cost around $150 each. With the burden and cost being carried by the companies for several years, the period of time to regain the lost revenue becomes problematic.

RMS also finds that the requirements for supporting needed offsets should be relaxed. Currently, Rule 69O-170-017. F.A.C. (3) reads “Filings can modify other rating factors to reflect revenue impact of current business only if they have actual information on policies receiving the discounts currently to support the modification.” This implies a full renewal cycle in order to determine actual impact on policies and does not address the issue of re-classifying the remaining policies (those not receiving the discounts). As seen, this information is critical to quantifying the company’s overall needed rate level for the group of policies being priced. Actual information on the entire book of business not yet reporting WMC information would require substantial time and money. RMS recommends that rigorously developed support of these remaining “unknown” rate needs be substituted for “actual information.”

The combination of a credit-only WMC implementation (which necessitates normalization to the worst-case house) and the difficulties in achieving concurrent, offsetting base rate increases, have led to premium level degradation over the last 3 years. While these problems may eventually self-correct, the length of time and resulting instability in rates makes the transition difficult.

Rated Total Premium compared to Modeled Total Premium

RMS extended its analysis to investigate the relationship between the rated AAL (incurred loss portion of premium) in the hybrid database and the modeled AAL for the same group of policies, using the RMS hurricane model. The absolute amount of each of these costs is not what is of interest, but the changes in the relationship between the two across fidelity levels are relevant. The modeled AAL is being used as the equivalent of the true risk described in Figure 9, which allows a comparison to be made of how the Rated Total Premium changes with the application of WMC information. Please note that this is not an evaluation of rate adequacy, which is beyond the scope of this project, and subject to many more considerations than included here.

The comparison in this section is on a total premium basis, which includes both wind and non-wind losses, expenses and reinsurance costs. This is done since total premium is what policyholders receive in their premium bills.

Development of Rated Total Premium

Rated AAL is the annualized amount of expected wind loss assigned to the hypothetical company policies. It is meant to cover loss payments from hurricanes. The rates are derived from I-File information and assigned to each county for the total insured value in that county. The rated total premium is developed with the premium rating algorithm described earlier for each property with specific WMC attributes.

Derivation of Modeled AAL

Modeled AALs come from RMS' RiskLink model as approved by the Florida Commission on Hurricane Projection Methodology. The same hybrid data base policies, used in the rated AALs are input into the model and the resulting modeled expected Average Annual Losses are used as the modeled AAL. Average Annual Loss (AAL) is the annualized (average) amount of expected loss from all events (hurricanes). It takes into account both frequency (how often) of hurricanes and severity (all Return Period losses) of damage from hurricane.

The AALs are the amounts that create the differences in the total premiums: Rated premium (using what the hypothetical company currently uses to cover its expected hurricane losses) is compared to modeled premium (using RiskLink modeled losses as the measure of expected hurricane losses). The other components (non-hurricane wind, non-wind, fixed expenses and reinsurance costs) remain unchanged. Variable losses and loss allocation costs remain the same percentage of AAL. The modeled AAL portion of the total premium is depicted in Figure 24 below.

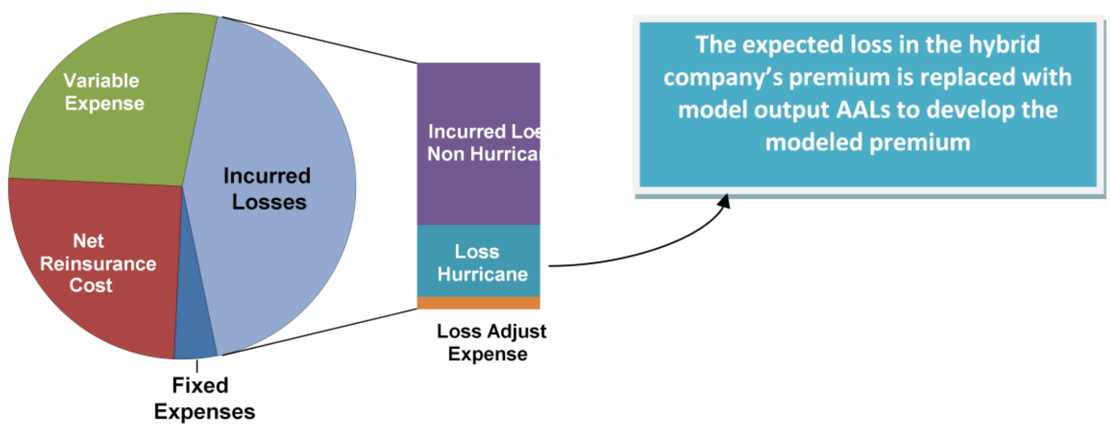


Figure 24: Building up Model version of total premium from Model derived AAL.

The graph in Figure 25 shows the change in the portfolio distribution of rated premiums versus modeled premiums. Note that modeled premiums are considered the true risk for locations in the portfolio and always consider specific WMC attributes in the risk levels. The rated premiums are initially developed without WMC information in the 0% fidelity case, and incrementally add WMC inspection information until we reach 100% fidelity. Rated and modeled premiums line up initially in the aggregate level with a distribution average of 1.0. At the 20% fidelity level, which is today's environment, a bump has developed where the charged premium is about 65% of the modeled premium. The buildings in the bump represent 17% of the 20% inspected (WMC) locations for this fidelity level and are driving the average of the distribution down to 0.80. These risks tend to be in south Florida and have large square footage, as seen in Table 14 and Table 15 below.

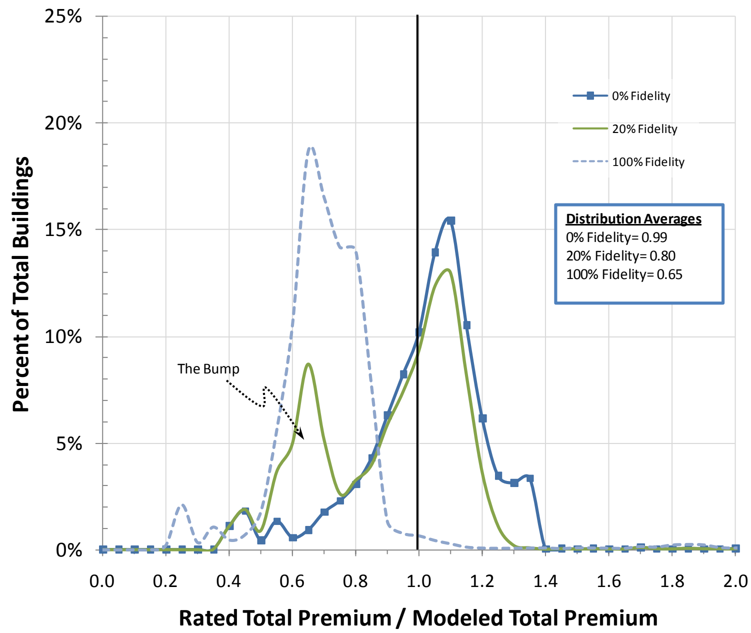


Figure 25: Change in distribution as inspections are added to the portfolio

Table 14: Distribution of buildings by county that are in "the bump" for the 20% fidelity case in Figure 25

County	Percent of Buildings
PALM BEACH COUNTY	30.10%
BROWARD COUNTY	29.93%
MIAMI-DADE COUNTY	27.86%
COLLIER COUNTY	7.86%
MONROE COUNTY	1.65%
BREVARD COUNTY	0.55%
PINELLAS COUNTY	0.46%
LEE COUNTY	0.29%
OKALOOSA COUNTY	0.26%
CHARLOTTE COUNTY	0.19%
SARASOTA COUNTY	0.18%
MARTIN COUNTY	0.10%
ESCAMBIA COUNTY	0.09%
PASCO COUNTY	0.07%
BAY COUNTY	0.07%
INDIAN RIVER COUNTY	0.06%
HERNANDO COUNTY	0.06%
HILLSBOROUGH COUNTY	0.05%
MANATEE COUNTY	0.03%

Table 15: Distribution of buildings by living area that are in “the bump” for the 20% fidelity case in Figure 25

Living Area (sq.ft.)	Percent
Unknown0	4.20%
<1500	18.16%
1500-2000	22.38%
2000-4500	46.44%
>4500	8.83%

The Bump buildings exhibit some features that are distributed differently than in the total insured population. Table 16 through Table 19 provides details. Roof shape and opening protection (shutters) features tend to be more wind-resistant in Bump policies, whilst roof deck attachment and roof anchorage are more typical, compared to the state levels. Because the rated/modeled premium ratio is significantly less than 1.0, it is certainly possible that these risks are ones that an insurance company would want to avoid having in its portfolio, which means there is a perverse consequence in the current system to actually discourage insurance companies from taking on risks that tend to be more hardened than average.

Table 16: Comparison of Distribution of buildings by roof shape that are in “the bump” for the 20% fidelity case in Figure 25

Roof Shape	The Bump	Total FL Insured Population
Gable	53.11%	70%
Hip	46.89%	30%

Table 17: Comparison of Distribution of buildings by Opening Protection that are in “the bump” for the 20% fidelity case in Figure 25

Opening Protection	The Bump	Total FL Insured Population
None	70.19%	91%
Basic Shutters	0.19%	1%
Hurricane Shutters	29.62%	8%

Table 18: Comparison of Distribution of buildings by Roof Deck Attachment that are in "the bump" for the 20% fidelity case in Figure 25

Roof Deck Attachment	The Bump	Total FL Insured Population
A	16.10%	24%
B	47.93%	39%
C	35.98%	35%

Table 19: Comparison of Distribution of buildings by Roof Anchor that are in "the bump" for the 20% fidelity case in Figure 25

Roof Anchor	The Bump	Total FL Insured Population
Toenail	0.56%	5%
Clip	11.33%	14%
Single wrap	69.61%	58%
Double wrap	18.50%	22%

Alternatives to the Present WMC Tables

The previous sections have described a variety of issues associated with the current implementation of the WMC factors. The key issues revolve around how well the base rate tables align with the WMC factors, and whether there is a mechanism to resolve the misalignment or not (i.e. adjust base rate tables). RMS has created a series of alternative scenarios to examine how different choices in the implementation of the WMC tables, or adjustments to the base rate tables would work out at today's fidelity level of 20% and ultimately what will happen when every home is inspected. These scenarios are listed in Table 20 and are described below. RMS has analyzed the changes in the context of our hypothetical insurance company by changing aspects of the premium rating algorithm described earlier. Recall that algorithm for our premium rating formula for our company has the form of:

$Premium = Rate * Coverage * (1 - Wind\% \ * WMC)$,

The scenarios below change either the Rate or the WMC portion of the equation and measure the impact on the resulting total premium. These scenarios have been applied from the Pre-WMC state of our company (i.e., the 0% fidelity) and have been designed to estimate the change in total premium after various fidelity states have been achieved, as shown in Figure 26. Discussions of what the scenarios represent conceptually and the meaning of the results are discussed below.

In all cases, RMS assumes that the inspection order is the same for all scenarios, and that all inspections continue to be voluntary. RMS has estimated the upper limit of the voluntary inspections can be expected for each of the scenarios. Each building is evaluated with the WMC variables from the hybrid database, and insurance saving in the first year as calculated from the currently applicable WMC tables are estimated for each scenario. The Max inspection percentage in

Table 20 corresponds to the fraction of the population that will save at least $250 dollars after the cost of the inspection in the first year. Naturally, for any of the scenarios that are normalized to a typical building, after around 50% fidelity has been achieved, it is likely that those who are below average would not report their characteristics since they are likely to result in rate increases.

Table 20: Wind mitigation credit rating scenarios considered in study

WMC Rating Scenario	WMC Table	Base Rate Table	Max Inspection Percentage*
Current WMC	OIR relativity table (normalized to weakest)	Rates pre WMC	80%
WMC Compressed	OIR relativity table compressed by 50%	Rates pre WMC	60%
Adjust Base Rate	OIR relativity table (normalized to weakest)	Base Rate table inflated by factor of approximately 1.45	90%
Stepwise Adjust Base Rate	OIR relativity table (normalized to weakest)	Base Rate table with phased-in increases to eventually reach full level needed.	90%
WMC Renormalized	OIR relativity table normalized to typical home.	Rates pre WMC	30%
WMC RMS Renormalized	RMS relativity table with 2002 variables normalized to typical	Rates pre WMC	45%

* Estimated % of the building population (fidelity level) that will participate in voluntary inspections and reporting assuming that savings from insurance premiums in first year are more than $250 greater than the cost of the inspection.

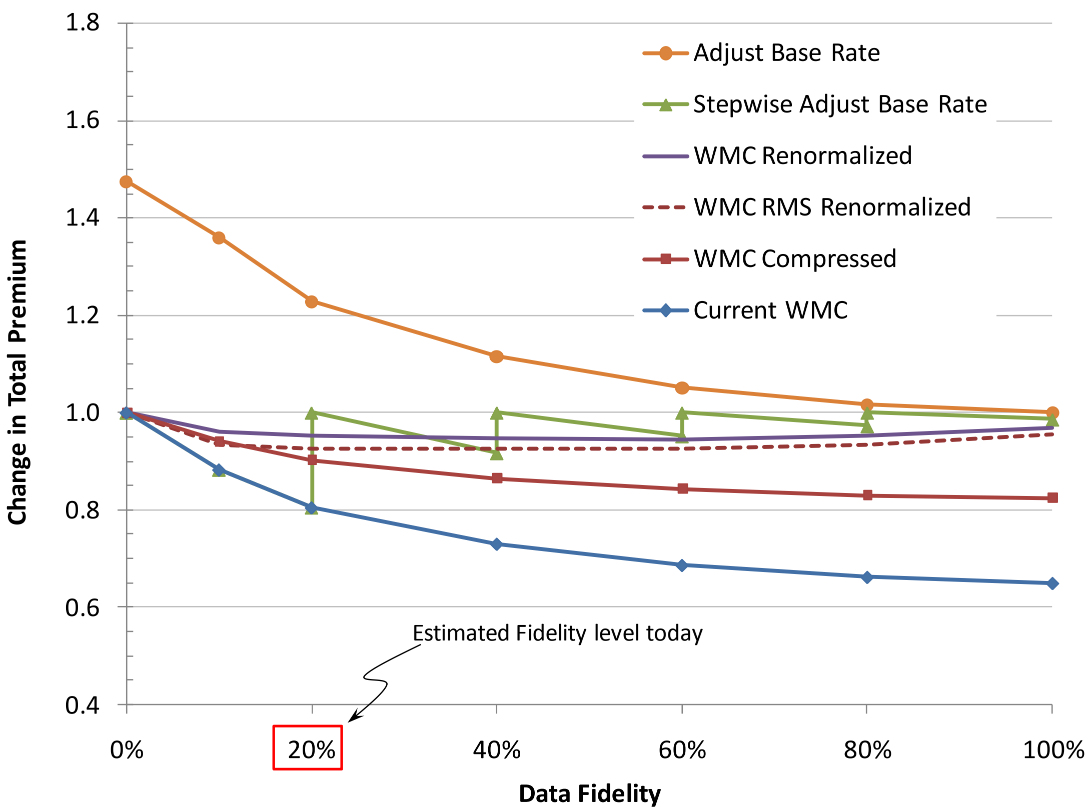


Figure 26: Comparison of total premium changes under different WMC scenarios.

The first scenario, **Current WMC,** in Figure 26, is our baseline case where we continue on the path at present, and is the same line as shown in Figure 17 earlier. At the present fidelity level of 20%, premiums are estimated to be 80% of a

Pre-WMC level. Should the current situation continue at present without any relief in base rate offsets, then statewide premiums would end up at 65%. The fidelity level is unlikely to move beyond 80% without intervention, but the damage is still the same at approximately 65% at this level.

The **WMC Compressed** scenario replaces the current OIR WMC table with previously recommended 50% compressed version of the ARA relativity study. Had that version been implemented from the start, then at today's fidelity level, the need for a base rate increase would only have been 10% as shown in the figure. At 100% fidelity the effect on the premiums is about half of the Current WMC scenario.

Another option is to keep the current, WMC table and allow insurers to increase their base rates. We will examine two scenarios in which we increase the base rate at different points of data fidelity. In the scenario **Adjust Base Rate**, the base rate table has been increased by a factor of approximately 1.45 to re align the base rate table with the WMC table that is normalized to the weakest building. This scenario would have economically forced homeowners get inspections or face significant increase in insurance premiums, and as expected our calculations indicate that almost 90% would voluntarily participate in the inspection process. At 0% fidelity, the analysis assumes everyone has taken a premium increase and then as additional data is collected, the level drops until it ends up at its pre-WMC point. In some ways, this is the opposite of the current situation – the rate level is set to be that of the base used (the weakest structure) and the reclassification information can be thought of as distributing the policies from the upper left hand corner of the WMC table throughout the cells of the table as the information dictating which cell each policy belongs in is collected. This treatment is likely to be unpopular with policyholders due to the magnitude of the initial rate increase, but has been included to see if this approach would have accelerated the hardening levels in the analysis in Section 5.

In the **Stepwise Adjust Base Rate** scenario, the base rate table is allowed to incrementally increase in steps ranging from 25% to 5% as needed at the defined fidelity percentages. This scenario demonstrates what can be expected as the normal rate indication process works its way through the system (*assuming* that companies can demonstrate the degree to which reclassification is happening). Thus, the increases start from today's fidelity level where RMS estimates a need for a 25% increase. As the fidelity level increases, the incremental rate need will decrease. This is due to our assumption that those who benefit the most from the WMCs were those who were the first group to provide information. Subsequent groups will have less to gain, which means their credits will be smaller, and the needed premium change for companies to keep even will also be smaller. The end result is the same as the first scenario, only the needed rates are phased in as the information is collected and eliminate the need for a drastic, one-time increase.

The opportunity also exists to implement the original WMC table produced in the 2002 ARA report and is shown in the **WMC Renormalized** scenario. Because this WMC table is normalized to a typical house, stronger houses would receive credits, while weaker houses would receive surcharges. This scenario also assumes that base rates would not change. Due to the asymmetrical reporting, if this strategy were adopted, the need for rate offsets for individual companies will remain as a course of action that might be needed, but as we can see in Figure 26, the magnitude of the expected offsets would be limited to approximately 5% instead of 20%. Because homes that are worse than typical would face a surcharge, the limit on voluntary inspections can be expected to cap out at 30% fidelity level.

Similarly, if the RMS model had been used with the same variables at the 2002 ARA study to create the WMC table, the **WMC RMS Renormalized** scenario shows that the premium erosion today would been approximately 10%. Slightly different results arise because the range between the weak and strong buildings is slightly larger in the RMS model which drives a few more people to inspection (Max inspection of 45%). This scenario demonstrates that the model results have some impact, but not as significant an impact as the normalization point.

It is important to remind readers at this point, that all of these scenarios are developed with our hypothetical company assuming that only re-classification activities are taking place in the portfolio, and that none of the homes have been hardened under these scenarios. The next section examines the mitigation incentive levels, or hardening levels that can be expected under each scenario. Consideration of just the results here indicates that scenarios that maintain the alignment of the base rate table and the WMC factors are preferable from a portfolio premium decay perspective, and thus almost all the scenarios other than the WMC compressed scenario would be preferred to the status quo.

Summary

While reductions to premiums have been mandated, there has been no corresponding reduction in expected loss or related expenses, based on the assumptions and analyses in this study. The premium alignments needed to maintain rate level arising from this mismatch have not been considered for immediate implementation. This has led to an approximate 24% change in overall premium level being currently necessary to restore the pre-WMC rate level.

A hypothetical insurance company's metrics were used to examine the components of premium decrease. Besides the mismatch, there is additional premium income erosion from a failure to adjust for the "new unknown," and for the differences that could result from the expanded credits needed to reflect risk levels, as described in section 2.

Data fidelity percentage will continue to increase until information on mitigation characteristics has been reported on a substantial portion of insured homes. Premium erosion will continue to worsen as more information is reported, although this is likely to occur less rapidly than it has up to this point. Six paths were explored, incorporating the effects of premium realignments and renormalization of loss cost relativities.

To complete the picture, incentives to promote hardening need to be explored and is explained in the following section.

Unfairly discriminatory rates

A rate is "fair" when it reflects the expected loss and related expenses covered by the premium charged for the coverage. When mitigation factors increase the knowledge related to that expected loss, they allow for more detailed pricing. Mitigation factors that are not known are properly reflected in rates as "unknown." It can be logically argued that incorporating mitigation characteristics into rates creates or allows a rate structure that is more "fair." However, rating characteristics and classifications must also be practical and achievable. When data is not available, it is not of much use in rating.

For rates to be evaluated as being unfairly discriminatory, they must be compared to other rates. If the relationship to expected loss is very different from one group to another, it's possible that unfair discrimination is present to some degree and such a situation may warrant further investigation.

The implementation of the WMC credits, appear to have had disparate impact on various segments of the insured population. There are likely cases where the relationship between expected loss and premium charged is greater than in other cases and has changed with the WMC application. However, this should not be the only measure used to investigate potential unfairly discriminatory rates since a plethora of other, potentially interrelated issues and characteristics are involved.

Solvency and Financial Position

There is seldom, if ever, a single cause of a company's insolvency. Florida had a number of companies with financial problems following Hurricane Andrew and a smaller number following the 2004/2005 seasons. The precipitating factor appeared to be a large number of severe claims following an extreme event, which exacerbated problems already in existence.

This study focused on the typical company and not on any one company or type of company. We did not analyze information related to surplus or cash availability levels. These are more appropriately addressed separately. Rating agencies and regulators have minimum capital levels and stress tests that are applied to each company to determine the financial wherewithal to start operations and continue in business.

WMC credits without a lowering of expected losses (which is what we are seeing today) can impact the amount of premium collected, which is likely to result in less money available for protection against catastrophic loss. This could come from results such as lower contributions to surplus, lower amounts purchased of traditional reinsurance or alternative risk transfer arrangements, fewer liquidity options, and lowered investment income.

Additional hardening, on the other hand, would mean that these decreased resources would be appropriately supported by lower expected losses. The decreased premium revenue would be supporting a lower level of loss, which could allow a company to retain its financial position and potentially expand its capacity to offer coverage.

This study did not address financial positions or solvency levels, nor was information related to those issues gathered or requested.

SECTION 5: EXAMINATION OF INCENTIVES FOR MITIGATION

This section adds another consideration to the WMC scenarios examined in Section 4 by estimating the number of buildings that will voluntarily under-take hardening to obtain insurance credits. The analysis for this section uses the same hypothetical insurance company framework as in Section 4. The information is built upon RMS' hybrid database and estimates the hardening cost for each building in the state. These analyses are different from those in the previous section in that instead of assuming that re-classification is the only activity resulting from inspection, the potential for a homeowner to transition from just getting an inspection to the point of actually hardening the building is examined.

This section explores how the WMC scenarios in Section 4 differ in their ability to promote actual hardening activities, adding another dimension upon which to compare the different WMC scenarios.

This analysis should be considered a lower bound estimate of hardening levels because there are other benefits such as increased personal safety, preservation of intangible values, and resiliency of homes and communities that will contribute to the choice of a property owner to harden their home.

Cost-Benefit Analysis Framework

The analysis framework is a Cost-Benefit Analysis which examines the annual net benefit for each mitigation alternative for the homeowner. This analysis involves estimating the cost of implementing each mitigation alternative, estimating the benefits of each mitigation alternative, and then comparing alternatives according to their net annual value.

Figure 27 shows the components included in the stakeholder analysis framework. These components include a) mitigation costing database to estimate the cost of hardening each home in the state, b) premium rating algorithm to estimate the change in insurance premium as mitigation packages are applied, and c) analysis methods to compare the costs and benefits.

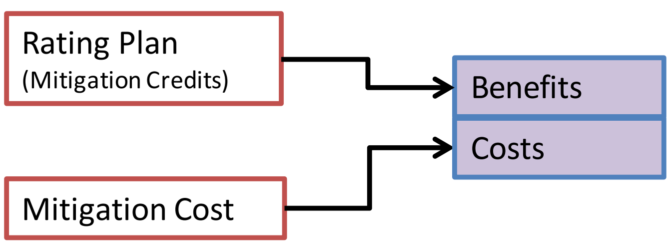


Figure 27: Analysis framework for stakeholder analysis.

Mitigation Packages and Costs

The two mitigation packages that are most likely to reduce property damage from future hurricanes are roof reinforcement and opening protection for windows and doors. These mitigation packages are considered separately and in combination, for a total of three mitigation options. The mitigation packages considered here are the same as those considered in the RMS evaluation of the My Safe Florida Home grant program [117].

<u>Mitigation I: Opening Protection</u>

For Windows: Windows are a key element in maintaining the integrity of a building's envelope and preventing losses during hurricanes. When windows fail, they allow wind and water to enter the building, creating conditions that increase the wind loads on elements such as the roof decking, which can lead to additional damage. The mitigation measures chosen to reduce the failure of windows are manufactured shutter products that have passed one of the impact test standards used in 2001 Florida Building Code, such as (PAS 201/202/203).

For Doors: Doors with poor wind resistance can expose the interior building components to wind and water hazards and may lead to internal pressurization, which can contribute to the failure of the roof structure. This modifier is mainly designed to address large door openings such as garage doors, sliding glass doors, and double-wide doors. It does not apply to tall commercial buildings. Damage is reduced where doors that are designed for wind pressure loads and have passed one of the wind-borne debris impact test standards used to rate wind shutters or are protected by impact rated shutters have been installed.

Mitigation II: Roof Reinforcement

Reducing Fastener Pull Through and Pull Out: Two of the most dominant types of failure modes in case of hurricanes are: (1) when fastener heads pull through the metal sheeting product, and (2) when the fasteners pull out of the framing members. By using thicker sheeting products one can ensure that fastener pull-through is reduced. To reduce fastener pull out, one needs to install more fasteners to reduce the load per fastener. The two retrofits selected for this case study include thicker sheeting and tighter screw spacing.

Roof Anchors: Roof anchors are used to connect the roof framing elements (i.e., rafters, trusses, or joists) to the supporting walls. Buildings that do not have properly sized and installed connections between the roof and supporting walls are susceptible to severe damage when the entire roof system is lifted off the building by a windstorm since only gravity holds the roof system down. High strength roof anchors typically wrap over the top of the roof framing element and are either fastened to the studs in the supporting wall or are wrapped under the top plate of the wall. High strength roof anchors typically have uplift resistances greater than 900 lbs.

Mitigation III: Opening Protection and Roof Upgrades

The two mitigation options above can also be combined to provide a more comprehensive level of protection for the structure. Wind losses are largely a result of component and cladding failures and to achieve the maximum level of protection one needs to have the entire system retrofitted. Table 21 provides estimates of the up-front cost of implementing such mitigation measures for a typical wood frame and masonry structures, assuming the costs are the same for both types of structures. Mitigation costs for the houses have been developed by RMS' survey of mitigation costs for contractors in Florida 2009. The mitigation costs estimated for each home take into account the size of the home and make estimates of the window and door area assuming typical industry ratios. Thus, the actual costs for each building are customized to incorporate the regional variations in the state as well as specific characteristics of that building.

Table 21: Average Mitigation Costs across all building in hypothetical company used in analysis

Mitigation Item	Cost (USD)
Windows- Engineered shutter	4725
Doors- designed for impact and pressured	1287
Roof Cover- Replace roof material with high wind version-designed for higher wind speed	10,445
Roof Deck- Attachment of sheathing to structure	607
Roof Anchor - High strength anchor	934

Quantifying the Benefits

From homeowner's perspective, Figure 27 shows that the benefits are derived from the insurance premium credit that results from applying the hardening measures. To quantify this benefit, RMS used the same premium rating algorithm as in the analysis in Section 4. The benefit is measured with respect to the "inspected" state of the building. In other words, if the premium was $1000 before the inspection, and $700 after the inspection (assuming a 30% credit for a hip roof, for example), the $700 dollar level becomes the basis for comparing to various mitigation options. So, if installing shutters results in a credit of 50% with respect to the pre-inspected state, then the benefit to the homeowner for installing shutters is $200 dollars per year. RMS has chosen this basis so that we can estimate how many homeowners simply stop after the inspection and how many go the extra distance to harden based on the incremental gains.

Calculating Net Annual Value: Comparing Costs and Benefits

Figure 28 illustrates the cash flow analysis for each mitigation package from homeowner perspective. An evaluation of the costs and benefits for each of the three mitigation packages has been performed for each building in the portfolio. It is assumed that individual homeowner is motivated to adopt a certain mitigation package only if this has a positive net annual benefit from their perspective. For some homeowners, it may not be cost effective to change the house at all for these packages. If more than one alternative produces a positive net annual benefit, the mitigation alternative with the highest net benefit will be adopted.

It is assumed that the homeowner will get a loan from bank to pay for the cost of mitigation implementation at an interest rate of 7% amortized over 5 years. The annual payment of the loan will be the cost that homeowner will consider in his annual net benefit calculations.

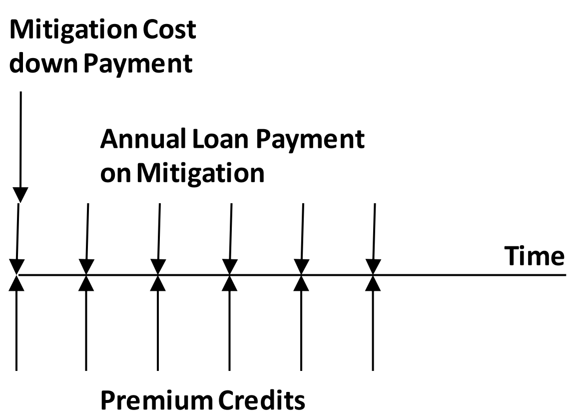


Figure 28: Components of Net Annual Payment Ratios

WMC Scenario Analysis

The same five scenarios considered in Section 4 are evaluated for their hardening incentive levels relative to the Current WMC scenario. The table from Section 4 that describes the scenarios is reproduced in Table 22. For each scenario, two fidelity levels are considered in analysis: First, the potential for hardening levels in the 20% data fidelity level is considered as representative of the current situation of the state. Second, hardening levels for the 100% fidelity level predict how many homeowners will ultimately participate after everyone is inspected. All of the scenarios are evaluated from the Pre-WMC situation. These cases do not assume a change in WMC tables after the 20% fidelity level, but compare outcomes had different choices been made in 2007.

Table 22: WMC rating scenarios from Section 4.

WMC Rating Scenario	WMC Table	Base Rate Table	Max Inspection Percentage*
Current WMC	OIR relativity table (normalized to weakest)	Rates pre WMC	80%
WMC Compressed	OIR relativity table compressed by 50%	Rates pre WMC	60%
Adjust Base Rate	OIR relativity table (normalized to weakest)	Base Rate table inflated by factor of approximately 1.45	90%
Stepwise Adjust Base Rate	OIR relativity table (normalized to weakest)	Base Rate table with phased-in increases to eventually reach full level needed.	90%
WMC Renormalized	OIR relativity table normalized to typical home.	Rates pre WMC	30%
WMC RMS Renormalized	RMS relativity table with 2002 variables normalized to typical	Rates pre WMC	45%

* Estimated % of the building population (fidelity level) that will participate in voluntary inspections and reporting assuming that savings from insurance premiums in first year are more than $250 greater than the cost of the inspection.

Results

Table 23 shows the estimated hardening level as the percentage of the total single family residential building population that will have positive net benefit value for different WMC scenarios and different fidelity levels. In other words, for each building the cost of adopting at least one of the three mitigation packages is less than the annual insurance premium savings.

Table 23: Comparison of hardening levels for different WMC scenarios with 5 year loan

Wind Mitigation Credit Scenario	20% Fidelity Level (Today)	100% Fidelity Level (All Inspected)
Current WMC	2%	4%
WMC Compressed	1%	1%
Adjust Base Rate	5%	13%
WMC Re-normalized	5%	12%
WMC RMS Re-normalized	10%	21%
Stepwise Adjust Base Rate	2%	13%

For the **Current WMC** scenario, the estimated hardening level today (with 20% of the population inspected) is very small at only 2% of the population. This hardening level is only expected to increase to 4% after everyone has had an inspection. This is a perverse consequence of a measure that was intended to promote hardening of the building stock. The large credits in this scenario actually undermines the incentive to harden by reducing the premium before mitigation to a point that an additional credit (of say 10-20%) for hardening on top of the "credit for re-classification" (say 35% for hip roof) results in a small absolute dollar amount. The table also shows that the results for the **WMC Compressed** scenario are approximately half as effective at promoting hardening since they functionally cut each credit amount in half.

If the base rates for insurance policies had been raised to align with the weakest building in the existing WMC table (**Adjust Base Rate**), then the hardening levels today would have been at 5% with projected levels eventually reaching 13%. This scenario has the advantage that over 90% of the population will participate in the inspection process, but as mentioned in Section 4, would require homeowners to absorb significant one-time premium increases.

Similar results can be seen for the **Stepwise Adjust Base Rate** case – the only difference being that the hardening level today would only 2%, but will eventually reach the same level as the Adjust Base Rate case as subsequent adjustments are made. When compared to the full increase of the **Adjust Base Rate** increase, this scenario's incremental adjustments to the base rate become more palatable with the same end result.

Normalizing with respect to a typical building, **WMC Re-normalized**, will also improve the hardening level. RMS estimates that had this scenario been implemented in 2007, the hardening level today would have been 5% and would have approached 12% eventually. Note that this case is similar to the Adjust Base Rate case indicating that it is the ultimate alignment of the base rates and the WMC factors that is important. The disadvantage of this case is that the voluntary inspections are likely to stop at the 30% fidelity level without any other intervention. However, as suggested in Section 4, this case has the advantage of not requiring rate level adjustments of approximately 5%.

While the **WMC Re-normalized** assumption to use credits with respect to the typical building is an improvement to the status quo, using the **WMC RMS Re-normalized** case shows a 10% hardening level today and 20% eventually. The wider variations between the weak and the strong, creates large incentives for the homeowner to invest in hardening.

In order to understand the unintended hardening disincentive built into the Current WMC case, Table 24 below illustrates, for a single building, how the different implementations of the WMC tables can affect the "benefit" for hardening efforts. The top half of the table shows the Current WMC credits before inspection (0%), after inspection with no hardening (assumed to be 58%), and after hardening measures, like hurricane shutters, have been implemented (assumed to be 70%). The equivalent credit factors for the other scenarios are shown in subsequent columns. The bottom half shows the calculated premium before and inspection, premium after hardening, and finally the incremental savings associated with hardening.

The examples in Table 24 show that the saving associated with hardening are only half of the value in the WMC Renormalized and Adjust Base Rate cases which is reflected in the hardening numbers reported above.

Table 24: Example calculations of insurance premium savings under selected WMC scenarios.

	Current WMC	WMC Compressed	WMC Renormalized	Adjust Base Rate
Credit Factors				
Before Inspection	0	0	0	0
After inspection	0.58	0.29	0.00	0.578
After Hardening	0.70	0.35	0.29	0.7
Estimated Premium				
Before Inspection	$5,000	$5,000	$5,000	$7,250
After inspection	$3,555	$4,278	$5,000	$5,155
After Hardening	$3,250	$4,125	$4,278	$4,713
Hardening Savings	$305	$153	$723	$442
Percent Diff (%)	0%	-50%	137%	45%

Note that the factor used to renormalize the WMC Renormalized case is 2.37 which is the relativity between the weak and typical home in Terrain B. The adjustment to the base rate in the "Adjust Base Rate" case is 1.45 which produces a revenue neutral adjustment for the entire portfolio. Calculations for this example assume that the wind% is 50% which actually varies by county.

This table demonstrates a subtle but important point. By choosing the weakest building as the normalization point and introducing a misalignment between the base rate table and the WMC factors, the system has basically compressed the relative difference between the inspected and hardened buildings. Table 24 indicates that amount of credit for hardening in Current WMC case is 12 percentage points, whereas the same credit is 29 percentage points in the WMC Renormalized case. Allowing the WMC system to be normalized with respect to the typical building actually provides more incentives to harden. Note that by allowing base rates to re-align (rise) with the WMC table will restore the potential to promote voluntary hardening once more, which is why the WMC Renormalized case and the Adjust Base Rate cases have similar hardening levels.

Comparison of Amortization Periods

The results in Table 25 assume an amortization of 5 years and annual mitigation costs are calculated based on an interest rate of 7 percent. If the amortization period is longer, then mitigation alternatives will be more attractive since the annual payments of a mitigation loan will be lower while the premium credits remain the same. Table 25 shows the comparison of the estimated hardening levels between the two amortization periods for each of the WMC scenarios and fidelity levels. Note that there is a large increase in the hardening levels associated with this longer amortization period. Our calculations indicate that under the WMC RMS Renormalized scenario the hardening levels could be as large at 50% of the population.

The sensitivity of the result to the amortization period assumption indicates that the promotion of hardened construction should not simply be expected to be generated by insurance credits alone. Other efforts to reduce the cost of mitigation by either spreading the cost over a longer time period, or offsets the cost through a grant program like the one formerly run with the MSFH program will be very effective at reducing overall loss levels. RMS recommends that consideration be given to these measures in addition to adjustments to the WMC tables.

Table 25: Comparison of hardening levels for different loan periods

	20% Fidelity Level (Today)		100% Fidelity Level (All Inspected)	
Wind Mitigation Credit Scenario	**5 Year Loan**	**30 year Loan**	**5 Year Loan**	**30 year Loan**
Current WMC	2%	9%	4%	19%
WMC Compressed	1%	3%	1%	7%
Adjust Base Rate	5%	14%	13%	38%
WMC Re-normalized	5%	14%	12%	39%
WMC RMS Re-normalized	10%	13%	21%	50%
Stepwise Adjust Base Rate	2%	10%	13%	38%

Limitations and Assumptions

The following assumptions and limitations should be noted with respect to the analysis in this section:

- This cost benefit analysis is based on a simple model of the insurance premium credits associated with our hypothetical insurance company. Necessary simplifications in the development of the premium rating algorithm, such as county level rating territories, were necessary and may affect the results from this analysis.
- To pay for mitigation, it is assumed that the homeowner obtains a home improvement loan from bank with a fixed interest rate and a loan period of 5 or 30 years.
- Assumptions about the cost of mitigation have been compiled from the best available information, but based on simplifying assumptions like the amount of window area in a typical wall to estimate the protection costs.

- Other costs and benefits from the homeowner perspective may factor into hardening decisions, and have not been included in this study.
- In calculating the percentage of the residential population that will harden their building over different scenarios, the exposure growth in different amortization periods is not considered.
- It is assumed that the homeowner will reside in the same building for duration of amortization period to reap the benefit of the applied hardening.

Summary

A benefit-cost analysis on each homeowner in our hypothetical insurance company portfolio has been performed from the perspective of the homeowner. Comparisons of the cost to harden versus the incremental insurance premium savings after an inspection have been made. The same WMC scenarios as in Section 4 were examined. Mitigation costs for each home have been estimated and assumed to be funded by a home improvement loan payable over 5 years.

RMS estimates that under the current WMC scenario, only 2% of the homes have been retrofitted at this time. The current magnitude of the credits undermines the incentives associated with hardening by reducing the premium amounts to the point that incremental changes to premium amounts associated with hardening are too small to incent mitigation efforts. RMS finds that had the WMC tables been implemented in a fashion that normalized to the typical building, the hardening levels would be projected to more than 10%, and if RMS' model had been used for the WMC table, the voluntary hardening levels could be as high as 20%.

Lastly, RMS examined the sensitivity of our estimated incentive levels to changes in the amortization period of the home improvement loan and has found that hardening levels can be doubled if the loan period is extended from 5 years to 30 years. These calculations indicate that voluntary hardening could increase to 50% of the population under these conditions. Changing the amortization period is just a way of reducing annual costs of the hardening measures versus annual insurance savings. There are variety of ways to reduce the mitigation costs which include the item studied here (longer amortization period) or may include grant programs like those that were found in the MSFH program, or other tax credits or tax incentives, similar to energy saving home improvements.

SECTION 6: CONCLUSIONS AND RECOMMENDATIONS

This report contains an analysis of the impact that windstorm mitigation credits (WMC) have had on the Florida insurance companies over the last three years. The windstorm mitigation credits were intended to promote the hardening of homes in the state, and were mandated to be part of insurance rate filings in 2000. A 2002 study by Applied Research Associates was used as the basis for a credit tables recommended by the Florida Office of Insurance Regulation, and were implemented in a compressed form normalized to what that study defined as the weakest building. In 2007, the recommended credits in use at the time were revised such that the compression was removed from the credit table. Since that time a decline in the average premium charged by insurance companies has been observed and underwriting losses for 109 of the 210 companies reported in 2009.

This study has created a series of analyses to determine the degree to which the WMC tables have impacted the premium and costs of the Florida insurance companies. This study is built upon the creation of a hypothetical insurance company that represents the aggregate of the voluntary insurance market. A unique feature of our analysis includes the development of a database that describes the windstorm mitigation credit attributes for the entire single family residential population. This unique dataset allows RMS to quantify how the voluntary collection of credit attributes through wind inspections has impacted the insurance company premiums costs and expenses.

Conclusions

RMS finds that the current implementation of the windstorm mitigation credits in the Florida residential insurance market is likely a significant contributing factor to the reported premium degradation over the last few years with little or no change in the inherent risk or associated fixed costs. At the root of the issue is the degree to which WMC information is reclassifying the existing building stock into different wind rating classes or whether hardening measures are taking affect in the population. At this point in time, RMS concludes that the collection of WMC data introduction into the insurance system is more related to reclassification of existing properties than about hardening.

RMS has designed, and conducted analyses and has reported on the issue in depth, and concludes that there are a number of contributing factors to this situation:

- Use of voluntary inspections to collect property information;
- Statutory language establishing the WMC system;
- The WMC normalization point and requirements for insurance base rate offsets;
- Impacts of the WMC system on reinsurance costs; and
- Modeling of residential property risk for WMC development.

Voluntary Inspections

The wind mitigation credit information that has been collected and recorded to date is not representative of the entire building stock in Florida. Data from the MSFH and other data sources suggest that current wind mitigation credit information is focused on high-value, already well-mitigated properties located in the highest hazard areas as they have the most to gain by early reporting of wind attributes. The information companies are seeing at this point in time is biased towards these “above average” risks, which leads to a need for offsetting base rate changes to retain an accurate reflection of a company’s group of policies.

Statutory Language

The current language in relevant Florida Statutes specifies that wind mitigation credits and discounts must be considered and included, but does not mention surcharges. While the intent is appropriate, effective implementation requires adjustments to average (typical) rates that may include surcharges as well as credits. Since insurance premiums are calculated starting with a typical or average cost, practicality dictates that recognition of mitigation features could make premiums go up as well as down.

Choice of Normalization Point for Credits

The current WMC tables are normalized to the weakest building on the table such that 99% of the population would receive a credit if 100% inspections are completed. This WMC table is being used in conjunction with insurance base rate tables, which contain premium amounts for the average risk in the territory – not the weakest building. Thus WMCs are being applied to an average rate for premium calculations, but the corresponding credit is relative to the weakest building. The OIR has testified that the choice of the weakest building as the normalized point was mandated by the language in the 2000 Florida statutes.

In theory, the choice of the building to use as the normalization point does not matter as long as there is a mechanism to eventually align the base rates with the WMC normalization point. However, the current regulatory environment is missing a practical mechanism for demonstrating a need for the "realignment" of base rates. Adjusting from credits developed as applicable to the average building (via loss ratio relativities) to credits applicable to the weakest building must either include the ability to adjust the overall level to that appropriate for the weakest building, or a recalibrating of the credits (loss ratio relativities) themselves.

Unlike our hypothetical company in this study, many insurance companies do not have a full characterization of the distribution of WMC attributes upon which offsetting calculations can be based. Companies must gather data on the "unknown" portion of their portfolio to demonstrate the need, but are instead focused on verifying already reported information.

The combination of the normalization point chosen and the restrictions on implementing base rate offsets has not only degraded premium revenue but also decreases the monetary incentives to harden homes. If adjustments are not made, only 4% of the population is likely to voluntarily harden their homes, under the current system, which is a perverse outcome of a system designed to promote overall hardening of the building stock.

Reinsurance Costs

RMS has studied whether WMC data will have an impact on reinsurance costs for insurance companies. Because the current data stream is more heavily reflective of reclassification versus hardening efforts, the WMC data simply acts to imply a reduction of portfolio risk that may not be valid.

Reinsurers are likely to not incorporate detailed mitigation feature information in their risk assessment until WMC data is available more widely across insurance portfolios to avoid possible biases associated with this data currently only being available for a limited subset of individual portfolios. So, while a primary insurer might have diminished premiums due to the WMC system, reinsurance costs can currently be expected to remain constant, applying further pressure to the primary company balance sheet.

Catastrophe Modeling

RMS evaluated the original 2002 study by Applied Research Associates used to create WMC recommendations, and noted differences between that study, a 2008 update by the same firm, and RMS' own hurricane model. RMS finds that differences among models are not a major contributor to the premium degradation or other systematic problems with the implementation of the WMC credits.

Recommendations

1. Insurance companies need to be able to correct the current misalignment between their WMC table and the base rates tables to alleviate premium degradation caused by the current WMC implementation. Premiums have been eroding since the full implementation of the WMCs was required during 2007, and is regionally dependent with drops as large as 40% in some south Florida counties. Correction of the misalignment will require some combination of renormalizing the WMC tables and/or allowing base rate increases to occur. The appropriate choice of technique is best made on an individual insurance company basis.
    a. The requirements for supporting needed offsets should be relaxed. Currently, Rule 69O-170-017. F.A.C. (3) reads "Filings can modify other rating factors to reflect revenue impact of current business only if they have actual information on policies receiving the discounts currently to support the modification." This implies a full renewal cycle in order to determine actual impact on policies and does not address the issue of reclassifying the remaining policies (those not receiving the discounts). As seen, this information is critical to quantifying the company's overall needed rate level for the group of policies being priced. Actual information on the entire book of business not yet reporting WMC information would require substantial time and money. RMS recommends that rigorously developed support of these remaining "unknown" rate needs be substituted for "actual information."
    b. The potential for overlaps in the Building Code Effectiveness Grading System adjustments and WMCs should be more thoroughly investigated. If any overlaps exist, they should be eliminated.
2. Renormalization
    a. F.S. 627.0629 (1)(a) should be revised to allow both credits and surcharges, and address the appropriate base for application. An unintended consequence of the current language is the difficulty OIR faces in allowing appropriate credit applications while complying with the law as it currently reads.
    b. RMS analysis recommends that WMC tables be normalized to an average house (in terms of wind risk exposure) as the base since this choice would both minimize base rate offsets needed and also promote additional hardening. As shown in Sections 4, continued application of the credit-only table leads to a continuing need for base rate increases, and Section 5 demonstrates the improved incentivizing resulting from the use of a typical house base.
3. Incentives to Mitigate
    a. RMS recommends reducing the homeowner cost to mitigate, which would strengthen the incentives to voluntarily harden homes. A grant program would be beneficial, as was seen with the My Safe Florida Home Program. Interest-free loans or the ability to amortize mitigation costs over longer period of times could be used. Consideration should be given to pursuing federal income tax benefits for mitigation activities, similar to energy saving home improvements.

4. Data

   Reliable, up to date data is critical to ensure that the industry can measure the degree to which risk classification versus hardening is occurring. To improve the quality of the mitigation data stream, RMS recommends changes to the current efforts to improve the FHCF data call so that:

   a. Reported variables align with the variables currently used in the UMVI form and therefore the WMC variables.

   b. Other key rating factors such as number of stories and square footage should be included.

   c. Isolate the unknown state of a variable separately (i.e., uninspected) so that the industry can measure the progression of data collection over time. For example, rather than combining “gable” and “unknown” categories,” the data call should require companies to identify these separately. This is a key issue that will make it easier to measure the degree to which re-classification versus hardening is happening in the state.

      This data should be available, with proper policyholder privacy protection, to modeling firms so that the most current scientific methods can be consistently validated by all modelers whose software is used in the state.

5. Catastrophe Modeling

   a. A full set of wind rating variables, identifying and measuring the full set of variables, should be included in the WMCs and phased into use by companies. Almost all of the FCHLPM-approved models are currently capable of providing valid loss relativities, and can be leveraged for these purposes.

   b. Some key rating factors that were not included in the 2002 study. Such as number of stories, roof slope, roof covering type and living area, should be included in the WMC tables.

   c. More geographically granular versions of the WMC tables should be created and aligned with company specific rating territories, rather than using 1 or 2 statewide aggregate tables.

RMS appreciates the opportunity to contribute to the understanding of an issue as critical as wind mitigation credits are to the state of Florida.

Limitations

This report has been prepared in accordance with the terms of an agreement between Risk Management Solutions (RMS) and the Department of Financial Services (DFS) of the state of Florida. This report, and the analyses, models and conclusions contained within, are based on publically available data on the insured residential properties at risk in the state of Florida and compiled using the RiskLink® catastrophe risk assessment system. The reliability of the loss estimates presented within this report is largely dependent on the accuracy and quality of data available to RMS.

The results contained herein are representative examples of potential impacts, and should not be interpreted to have meaning outside the context of this report. Simplifying assumptions and selections have been made to facilitate the analysis, although every effort has been made to retain a realistic portrayal of conditions. The results are not applicable to any specific company; rather, they represent a snapshot of the personal residential property insurance market in Florida over the range of time described in the report.

Available premium information was at the county level, which contains details that represent the average or aggregate of risks within that county. Wide variations within each county will exist. Our methodology was guided by the requirements of the Florida OIR’s I-File online requirements, as well as related information publicly available via the OIR’s I-File system. The indications and assumptions are not actuarial rate indications. Different results could be obtained from reasonable alternative starting points, assumptions, data, and/or methodologies.

Analysis of the mitigation credits levels should be interpreted as described within and should not be used without additional analysis, which may include substantial adjustments, for any other purpose.

It should be emphasized that this analysis does not assess the absolute adequacy of insurance rates; rather, the analysis assesses the adequacy of rates in the context of the intent versus implementation of the WMCs. This report focuses on asymmetrical/biased data collection, as explained in the report. All analyses, data, assumptions and methodologies, except where specifically noted otherwise, have been completed based on this condition.

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APPENDIX A: HURRICANE MODEL RELATIVITY TABLES

List of exhibits;

A-1: Terrain B Wind Mitigation Relativity Table from 2002 ARA Report [3]

A-2: Terrain C Wind Mitigation Relativity Table from 2002 ARA Report [3]

A-3: Terrain B Credits (2002 vs. 2008) in 2008 ARA Study [Source: Table 1-1 from ARA Memo, [114]

A-4: Terrain C Credits (2002 vs. 2008) in 2008 ARA Study [Source: Table 1-1 from ARA Memo, [114]

A-4: Terrain C Credits (2002 vs. 2008) in 2008 ARA Study [Source: Table 1-1 from ARA Memo, [114]

A-5: Terrain B Wind Mitigation Relativities (2002 vs. 2008)

A-6: Terrain C Wind Mitigation Relativities (2002 vs. 2008)

A-7: Comparison of ARA 2002 and RMS wind mitigation relativity – Terrain B

A-8: Comparison of ARA 2002 and RMS wind mitigation relativity – Terrain C

A-9: Comparison of ARA 2002 and RMS wind mitigation credits – Terrain B

A-10: Comparison of ARA 2002 and RMS wind mitigation credits – Terrain C

A-11: Form OIR-B1-1699 Windstorm Mitigation Credits adopted in March 2007

Exhibit A-1: Terrain B Relativity Table from 2002 ARA report [3]

				Roof Shape			
				Other		Hip	
Roof Cover	Roof Deck Attachment	Roof-Wall Attachment	Opening Protection	No SWR	SWR	No SWR	SWR
Non-FBC Equivalent	A	Toe-Nails	None	2.37	2.22	1.26	1.18
			Basic	1.53	1.37	0.91	0.83
			Hurricane	1.33	1.15	0.80	0.71
		Clips	None	1.55	1.37	0.91	0.80
			Basic	1.26	1.08	0.75	0.65
			Hurricane	1.19	1.01	0.72	0.61
		Single Wraps	None	1.53	1.35	0.91	0.79
			Basic	1.25	1.07	0.75	0.65
			Hurricane	1.19	1.00	0.72	0.61
		Double Wraps	None	1.53	1.35	0.91	0.80
			Basic	1.25	1.07	0.75	0.65
			Hurricane	1.19	1.00	0.72	0.61
	B	Toe-Nails	None	2.16	2.05	1.22	1.14
			Basic	1.27	1.17	0.88	0.81
			Hurricane	1.04	0.92	0.76	0.68
		Clips	None	1.00	0.84	0.76	0.64
			Basic	0.84	0.71	0.65	0.56
			Hurricane	0.80	0.66	0.63	0.55
		Single Wraps	None	0.95	0.76	0.75	0.64
			Basic	0.79	0.64	0.64	0.55
			Hurricane	0.77	0.63	0.63	0.55
		Double Wraps	None	0.94	0.76	0.75	0.64
			Basic	0.79	0.63	0.64	0.55
			Hurricane	0.77	0.62	0.63	0.55
	C	Toe-Nails	None	2.15	2.04	1.22	1.15
			Basic	1.27	1.16	0.88	0.81
			Hurricane	1.03	0.92	0.75	0.68
		Clips	None	0.98	0.82	0.75	0.64
			Basic	0.82	0.70	0.64	0.56
			Hurricane	0.78	0.66	0.63	0.55
		Single Wraps	None	0.91	0.73	0.75	0.63
			Basic	0.77	0.63	0.64	0.55
			Hurricane	0.75	0.62	0.63	0.55
		Double Wraps	None	0.90	0.72	0.75	0.63
			Basic	0.75	0.61	0.64	0.55
			Hurricane	0.74	0.61	0.63	0.54
FBC Equivalent	A	Toe-Nails	None	2.11	2.05	1.07	1.04
			Basic	1.26	1.22	0.71	0.69
			Hurricane	1.03	0.99	0.59	0.57
		Clips	None	1.22	1.19	0.67	0.65
			Basic	0.94	0.91	0.53	0.51
			Hurricane	0.88	0.84	0.49	0.47
		Single Wraps	None	1.21	1.18	0.67	0.65
			Basic	0.94	0.90	0.53	0.51
			Hurricane	0.87	0.84	0.49	0.47
		Double Wraps	None	1.21	1.17	0.67	0.65
			Basic	0.93	0.90	0.53	0.51
			Hurricane	0.87	0.83	0.49	0.47
	B	Toe-Nails	None	1.95	1.90	1.03	1.01
			Basic	1.06	1.02	0.69	0.67
			Hurricane	0.80	0.78	0.56	0.55
		Clips	None	0.72	0.69	0.53	0.50
			Basic	0.59	0.56	0.44	0.42
			Hurricane	0.54	0.51	0.43	0.41
		Single Wraps	None	0.65	0.61	0.52	0.50
			Basic	0.53	0.49	0.43	0.41
			Hurricane	0.51	0.48	0.43	0.41
		Double Wraps	None	0.65	0.60	0.52	0.50
			Basic	0.52	0.48	0.43	0.41
			Hurricane	0.51	0.47	0.43	0.41
	C	Toe-Nails	None	1.94	1.89	1.03	1.01
			Basic	1.05	1.02	0.69	0.67
			Hurricane	0.80	0.77	0.56	0.55
		Clips	None	0.70	0.67	0.52	0.50
			Basic	0.58	0.55	0.44	0.42
			Hurricane	0.53	0.51	0.43	0.41
		Single Wraps	None	0.62	0.58	0.52	0.49
			Basic	0.51	0.48	0.43	0.41
			Hurricane	0.49	0.47	0.42	0.41
		Double Wraps	None	0.61	0.57	0.52	0.49
			Basic	0.50	0.46	0.43	0.41
			Hurricane	0.49	0.46	0.42	0.41

Exhibit A-2: Terrain C Relativity Table from 2002 ARA report [3]

Roof Cover	Roof Deck Attachment	Roof-Wall Attachment	Opening Protection	Roof Shape: Other, No SWR	Roof Shape: Other, SWR	Roof Shape: Hip, No SWR	Roof Shape: Hip, SWR
Non-FBC Equivalent	A	Toe-Nails	None	1.60	1.49	1.16	1.09
Non-FBC Equivalent	A	Toe-Nails	Basic	1.13	0.99	0.71	0.61
Non-FBC Equivalent	A	Toe-Nails	Hurricane	0.98	0.83	0.57	0.45
Non-FBC Equivalent	A	Clips	None	1.31	1.19	0.89	0.79
Non-FBC Equivalent	A	Clips	Basic	0.99	0.83	0.58	0.45
Non-FBC Equivalent	A	Clips	Hurricane	0.90	0.73	0.51	0.38
Non-FBC Equivalent	A	Single Wraps	None	1.28	1.15	0.88	0.78
Non-FBC Equivalent	A	Single Wraps	Basic	0.97	0.81	0.58	0.45
Non-FBC Equivalent	A	Single Wraps	Hurricane	0.90	0.73	0.51	0.38
Non-FBC Equivalent	A	Double Wraps	None	1.27	1.15	0.88	0.78
Non-FBC Equivalent	A	Double Wraps	Basic	0.97	0.81	0.58	0.45
Non-FBC Equivalent	A	Double Wraps	Hurricane	0.90	0.73	0.51	0.38
Non-FBC Equivalent	B	Toe-Nails	None	1.46	1.37	1.13	1.07
Non-FBC Equivalent	B	Toe-Nails	Basic	0.89	0.80	0.65	0.58
Non-FBC Equivalent	B	Toe-Nails	Hurricane	0.72	0.62	0.50	0.42
Non-FBC Equivalent	B	Clips	None	1.00	0.89	0.69	0.56
Non-FBC Equivalent	B	Clips	Basic	0.60	0.47	0.43	0.33
Non-FBC Equivalent	B	Clips	Hurricane	0.49	0.35	0.39	0.28
Non-FBC Equivalent	B	Single Wraps	None	0.84	0.68	0.64	0.47
Non-FBC Equivalent	B	Single Wraps	Basic	0.53	0.38	0.41	0.30
Non-FBC Equivalent	B	Single Wraps	Hurricane	0.48	0.32	0.38	0.28
Non-FBC Equivalent	B	Double Wraps	None	0.79	0.59	0.63	0.45
Non-FBC Equivalent	B	Double Wraps	Basic	0.51	0.34	0.41	0.29
Non-FBC Equivalent	B	Double Wraps	Hurricane	0.47	0.31	0.38	0.27
Non-FBC Equivalent	C	Toe-Nails	None	1.45	1.37	1.13	1.07
Non-FBC Equivalent	C	Toe-Nails	Basic	0.88	0.79	0.65	0.58
Non-FBC Equivalent	C	Toe-Nails	Hurricane	0.71	0.62	0.50	0.42
Non-FBC Equivalent	C	Clips	None	0.98	0.88	0.69	0.56
Non-FBC Equivalent	C	Clips	Basic	0.57	0.46	0.43	0.33
Non-FBC Equivalent	C	Clips	Hurricane	0.46	0.34	0.38	0.28
Non-FBC Equivalent	C	Single Wraps	None	0.81	0.64	0.63	0.44
Non-FBC Equivalent	C	Single Wraps	Basic	0.49	0.36	0.40	0.29
Non-FBC Equivalent	C	Single Wraps	Hurricane	0.43	0.30	0.38	0.27
Non-FBC Equivalent	C	Double Wraps	None	0.72	0.47	0.62	0.41
Non-FBC Equivalent	C	Double Wraps	Basic	0.45	0.30	0.39	0.27
Non-FBC Equivalent	C	Double Wraps	Hurricane	0.42	0.28	0.37	0.26
FBC Equivalent	A	Toe-Nails	None	1.49	1.44	1.07	1.03
FBC Equivalent	A	Toe-Nails	Basic	0.97	0.93	0.59	0.56
FBC Equivalent	A	Toe-Nails	Hurricane	0.81	0.77	0.43	0.40
FBC Equivalent	A	Clips	None	1.16	1.12	0.75	0.73
FBC Equivalent	A	Clips	Basic	0.80	0.76	0.43	0.39
FBC Equivalent	A	Clips	Hurricane	0.71	0.67	0.36	0.32
FBC Equivalent	A	Single Wraps	None	1.12	1.09	0.75	0.72
FBC Equivalent	A	Single Wraps	Basic	0.79	0.74	0.43	0.39
FBC Equivalent	A	Single Wraps	Hurricane	0.71	0.66	0.36	0.32
FBC Equivalent	A	Double Wraps	None	1.12	1.08	0.75	0.72
FBC Equivalent	A	Double Wraps	Basic	0.78	0.74	0.43	0.39
FBC Equivalent	A	Double Wraps	Hurricane	0.71	0.66	0.36	0.32
FBC Equivalent	B	Toe-Nails	None	1.36	1.32	1.04	1.01
FBC Equivalent	B	Toe-Nails	Basic	0.78	0.75	0.55	0.53
FBC Equivalent	B	Toe-Nails	Hurricane	0.60	0.57	0.38	0.36
FBC Equivalent	B	Clips	None	0.87	0.84	0.54	0.51
FBC Equivalent	B	Clips	Basic	0.46	0.42	0.31	0.28
FBC Equivalent	B	Clips	Hurricane	0.35	0.30	0.26	0.23
FBC Equivalent	B	Single Wraps	None	0.68	0.63	0.46	0.41
FBC Equivalent	B	Single Wraps	Basic	0.38	0.33	0.28	0.24
FBC Equivalent	B	Single Wraps	Hurricane	0.32	0.27	0.26	0.22
FBC Equivalent	B	Double Wraps	None	0.60	0.53	0.45	0.39
FBC Equivalent	B	Double Wraps	Basic	0.35	0.29	0.27	0.23
FBC Equivalent	B	Double Wraps	Hurricane	0.32	0.26	0.25	0.22
FBC Equivalent	C	Toe-Nails	None	1.36	1.32	1.04	1.01
FBC Equivalent	C	Toe-Nails	Basic	0.78	0.74	0.55	0.53
FBC Equivalent	C	Toe-Nails	Hurricane	0.59	0.56	0.39	0.36
FBC Equivalent	C	Clips	None	0.86	0.83	0.54	0.50
FBC Equivalent	C	Clips	Basic	0.44	0.41	0.30	0.27
FBC Equivalent	C	Clips	Hurricane	0.32	0.29	0.26	0.23
FBC Equivalent	C	Single Wraps	None	0.64	0.59	0.45	0.39
FBC Equivalent	C	Single Wraps	Basic	0.35	0.31	0.27	0.23
FBC Equivalent	C	Single Wraps	Hurricane	0.29	0.25	0.25	0.22
FBC Equivalent	C	Double Wraps	None	0.51	0.41	0.43	0.36
FBC Equivalent	C	Double Wraps	Basic	0.30	0.25	0.26	0.22
FBC Equivalent	C	Double Wraps	Hurricane	0.28	0.23	0.25	0.21

Exhibit A-3: Terrain B Credits (2002 vs. 2008) in 2008 ARA study [Source: Table 1-1 from ARA Memo [114]

Deductible 2% - Terrain B				Terrain B											
				2002 Credits in Comparable 2002:2008 Format				2008 Credits in Comparable 2002:2008 Format				2002-2008 Credits in Comp. 2002:2008 Format			
				Roof Shape				Roof Shape				Roof Shape			
				Other		Hip		Other		Hip		Other		Hip	
Roof Cover	Roof Deck Attachment	Roof-Wall Connection	Opening Protection	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR
Non-FBC Equivalent	A. (6d @ 6"/12")	Toe Nails	None	0.00	0.06	0.47	0.50	0.00	0.06	0.47	0.50	0.00	0.00	0.00	0.01
			Hurricane	0.44	0.51	0.66	0.70	0.24	0.30	0.53	0.55	0.20	0.21	0.13	0.15
		Clips	None	0.35	0.42	0.62	0.66	0.14	0.21	0.49	0.51	0.21	0.22	0.13	0.15
			Hurricane	0.50	0.57	0.70	0.74	0.26	0.33	0.53	0.55	0.23	0.25	0.16	0.19
		Single Wraps	None	0.35	0.43	0.62	0.67	0.15	0.21	0.49	0.51	0.20	0.22	0.13	0.16
			Hurricane	0.50	0.58	0.70	0.74	0.26	0.33	0.53	0.55	0.23	0.25	0.16	0.19
	B. (8d @ 6"/12")	Toe Nails	None	0.09	0.14	0.49	0.52	0.14	0.18	0.50	0.52	-0.05	-0.04	-0.02	0.00
			Hurricane	0.56	0.61	0.68	0.71	0.39	0.43	0.55	0.56	0.17	0.19	0.13	0.15
		Clips	None	0.58	0.65	0.68	0.73	0.36	0.41	0.53	0.55	0.22	0.24	0.15	0.18
			Hurricane	0.66	0.72	0.73	0.77	0.43	0.47	0.55	0.57	0.24	0.25	0.18	0.20
		Single Wraps	None	0.60	0.68	0.68	0.73	0.39	0.44	0.53	0.55	0.21	0.24	0.16	0.18
			Hurricane	0.68	0.73	0.73	0.77	0.43	0.48	0.55	0.57	0.25	0.26	0.18	0.20
	C. (8d @ 6"/6")	Toe Nails	None	0.09	0.14	0.49	0.51	0.14	0.18	0.50	0.52	-0.05	-0.04	-0.02	-0.01
			Hurricane	0.57	0.61	0.68	0.71	0.39	0.43	0.55	0.56	0.17	0.18	0.14	0.15
		Clips	None	0.59	0.65	0.68	0.73	0.37	0.41	0.53	0.55	0.22	0.24	0.15	0.18
			Hurricane	0.67	0.72	0.73	0.77	0.43	0.47	0.55	0.57	0.24	0.25	0.18	0.20
		Single Wraps	None	0.62	0.69	0.68	0.73	0.40	0.45	0.53	0.55	0.21	0.24	0.15	0.18
			Hurricane	0.68	0.74	0.73	0.77	0.44	0.48	0.55	0.57	0.25	0.26	0.18	0.20
FBC Equivalent	A. (6d @ 6"/12")	Toe Nails	None	0.11	0.14	0.55	0.56	0.25	0.27	0.64	0.65	-0.14	-0.13	-0.09	-0.08
			Hurricane	0.57	0.58	0.75	0.76	0.51	0.51	0.71	0.71	0.06	0.07	0.05	0.05
		Clips	None	0.49	0.50	0.72	0.73	0.41	0.42	0.66	0.66	0.07	0.08	0.06	0.07
			Hurricane	0.63	0.65	0.79	0.80	0.53	0.54	0.71	0.71	0.10	0.11	0.08	0.09
		Single Wraps	None	0.49	0.50	0.72	0.73	0.43	0.43	0.66	0.66	0.06	0.07	0.06	0.06
			Hurricane	0.63	0.65	0.79	0.80	0.53	0.54	0.71	0.71	0.10	0.11	0.08	0.09
	B. (8d @ 6"/12")	Toe Nails	None	0.18	0.20	0.57	0.57	0.36	0.37	0.66	0.67	-0.18	-0.18	-0.10	-0.09
			Hurricane	0.66	0.67	0.76	0.77	0.62	0.63	0.71	0.72	0.04	0.04	0.05	0.05
		Clips	None	0.70	0.71	0.78	0.79	0.60	0.60	0.69	0.70	0.10	0.10	0.08	0.09
			Hurricane	0.77	0.78	0.82	0.83	0.66	0.67	0.72	0.72	0.11	0.12	0.09	0.10
		Single Wraps	None	0.73	0.74	0.78	0.79	0.63	0.64	0.69	0.70	0.09	0.10	0.09	0.09
			Hurricane	0.78	0.80	0.82	0.83	0.67	0.67	0.72	0.72	0.11	0.12	0.09	0.10
	C. (8d @ 6"/6")	Toe Nails	None	0.18	0.20	0.57	0.57	0.36	0.37	0.66	0.67	-0.18	-0.17	-0.10	-0.09
			Hurricane	0.66	0.68	0.76	0.77	0.62	0.63	0.71	0.72	0.04	0.05	0.05	0.05
		Clips	None	0.70	0.72	0.78	0.79	0.60	0.61	0.69	0.70	0.10	0.11	0.09	0.09
			Hurricane	0.78	0.78	0.82	0.83	0.67	0.67	0.72	0.72	0.11	0.12	0.09	0.10
		Single Wraps	None	0.74	0.76	0.78	0.79	0.64	0.64	0.69	0.70	0.10	0.11	0.09	0.10
			Hurricane	0.79	0.80	0.82	0.83	0.68	0.68	0.72	0.72	0.12	0.12	0.10	0.10

Exhibit A-4: Terrain C Credits (2002 vs. 2008) in comparable format [Source: Table 1-3 from ARA Memo [114]

Deductible 2% - Terrain C				Terrain C											
				2002 Credits in Comparable 2002:2008 Format				2008 Credits in Comparable 2002:2008 Format				2002-2008 Credits in Comp. 2002:2008 Format			
				Roof Shape				Roof Shape				Roof Shape			
				Other		Hip		Other		Hip		Other		Hip	
Roof Cover	Roof Deck Attachment	Roof-Wall Connection	Opening Protection	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR
Non-FBC Equivalent	A. (6d @ 6"/12")	Toe Nails	None	0.00	0.07	0.28	0.32	0.00	0.07	0.42	0.45	0.00	0.00	-0.15	-0.13
			Hurricane	0.39	0.48	0.64	0.72	0.38	0.46	0.66	0.69	0.00	0.02	-0.01	0.03
		Clips	None	0.18	0.26	0.44	0.51	0.16	0.23	0.49	0.52	0.02	0.02	-0.04	-0.01
			Hurricane	0.44	0.54	0.68	0.76	0.40	0.48	0.66	0.69	0.04	0.07	0.02	0.07
		Single Wraps	None	0.20	0.28	0.45	0.51	0.20	0.27	0.49	0.52	0.00	0.01	-0.04	-0.01
			Hurricane	0.44	0.54	0.68	0.76	0.40	0.48	0.66	0.69	0.04	0.06	0.02	0.07
	B. (8d @ 6"/12")	Toe Nails	None	0.09	0.14	0.29	0.33	0.13	0.19	0.45	0.48	-0.04	-0.04	-0.15	-0.14
			Hurricane	0.55	0.61	0.69	0.74	0.57	0.62	0.69	0.71	-0.02	-0.01	0.00	0.03
		Clips	None	0.38	0.44	0.57	0.65	0.36	0.42	0.59	0.63	0.01	0.03	-0.02	0.02
			Hurricane	0.69	0.78	0.76	0.83	0.61	0.67	0.69	0.72	0.08	0.11	0.06	0.11
		Single Wraps	None	0.48	0.58	0.60	0.71	0.47	0.54	0.61	0.65	0.00	0.04	-0.01	0.05
			Hurricane	0.70	0.80	0.76	0.83	0.62	0.67	0.69	0.72	0.08	0.13	0.07	0.11
	C. (8d @ 6"/6")	Toe Nails	None	0.09	0.14	0.29	0.33	0.14	0.19	0.45	0.48	-0.05	-0.05	-0.15	-0.14
			Hurricane	0.56	0.61	0.69	0.74	0.58	0.62	0.69	0.71	-0.02	-0.01	0.00	0.03
		Clips	None	0.39	0.45	0.57	0.65	0.37	0.42	0.59	0.63	0.02	0.03	-0.02	0.02
			Hurricane	0.71	0.79	0.76	0.83	0.62	0.67	0.69	0.72	0.09	0.11	0.07	0.11
		Single Wraps	None	0.49	0.60	0.61	0.73	0.49	0.55	0.62	0.66	0.00	0.05	-0.01	0.07
			Hurricane	0.73	0.81	0.76	0.83	0.63	0.68	0.69	0.72	0.10	0.13	0.07	0.11
FBC Equivalent	A. (6d @ 6"/12")	Toe Nails	None	0.07	0.10	0.33	0.36	0.16	0.19	0.53	0.54	-0.09	-0.09	-0.20	-0.18
			Hurricane	0.49	0.52	0.73	0.75	0.57	0.58	0.78	0.78	-0.08	-0.06	-0.05	-0.03
		Clips	None	0.28	0.30	0.53	0.54	0.33	0.35	0.61	0.62	-0.06	-0.05	-0.08	-0.07
			Hurricane	0.56	0.58	0.78	0.80	0.59	0.60	0.78	0.78	-0.03	-0.01	-0.01	0.02
		Single Wraps	None	0.30	0.32	0.53	0.55	0.38	0.39	0.61	0.62	-0.08	-0.07	-0.08	-0.07
			Hurricane	0.56	0.59	0.78	0.80	0.59	0.60	0.78	0.78	-0.03	-0.01	-0.01	0.02
	B. (8d @ 6"/12")	Toe Nails	None	0.15	0.18	0.35	0.37	0.26	0.28	0.55	0.56	-0.11	-0.11	-0.20	-0.19
			Hurricane	0.63	0.64	0.76	0.78	0.72	0.72	0.80	0.80	-0.09	-0.08	-0.03	-0.02
		Clips	None	0.46	0.48	0.66	0.68	0.50	0.52	0.71	0.71	-0.04	-0.04	-0.05	-0.03
			Hurricane	0.78	0.81	0.84	0.86	0.76	0.77	0.80	0.81	0.02	0.05	0.03	0.05
		Single Wraps	None	0.58	0.61	0.71	0.74	0.63	0.64	0.74	0.74	-0.06	-0.03	-0.03	0.00
			Hurricane	0.80	0.83	0.84	0.86	0.77	0.78	0.80	0.81	0.03	0.06	0.03	0.06
	C. (8d @ 6"/6")	Toe Nails	None	0.15	0.18	0.35	0.37	0.26	0.29	0.55	0.56	-0.11	-0.11	-0.20	-0.19
			Hurricane	0.63	0.65	0.76	0.78	0.72	0.73	0.80	0.80	-0.09	-0.08	-0.04	-0.02
		Clips	None	0.46	0.48	0.66	0.69	0.51	0.52	0.71	0.71	-0.04	-0.04	-0.05	-0.03
			Hurricane	0.80	0.82	0.84	0.86	0.77	0.77	0.80	0.81	0.03	0.05	0.03	0.05
		Single Wraps	None	0.60	0.63	0.72	0.76	0.64	0.65	0.74	0.74	-0.04	-0.02	-0.02	0.01
			Hurricane	0.82	0.84	0.84	0.86	0.78	0.78	0.80	0.81	0.04	0.06	0.04	0.06

Exhibit A-5: Terrain B Wind mitigation Relativities (2002 vs. 2008)]

Deductible 2% - Terrain B				Terrain B											
				2002 Credits in Comparable 2002:2008 Format				2008 Credits in Comparable 2002:2008 Format				2002-2008 Credits in Comp. 2002:2008 Format			
				Roof Shape				Roof Shape				Roof Shape			
				Other		Hip		Other		Hip		Other		Hip	
Roof Cover	Roof Deck Attachment	Roof-Wall Connection	Opening Protection	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR
Non-FBC Equivalent	A. (6d @ 6"/12")	Toe Nails	None	2.37	2.23	1.26	1.19	1.57	1.47	0.83	0.78	-0.80	-0.75	-0.43	-0.40
			Hurricane	1.33	1.16	0.81	0.71	1.19	1.10	0.74	0.71	-0.14	-0.06	-0.07	-0.01
		Clips	None	1.54	1.37	0.90	0.81	1.35	1.24	0.80	0.77	-0.19	-0.14	-0.10	-0.04
			Hurricane	1.19	1.02	0.71	0.62	1.16	1.05	0.74	0.71	-0.02	0.03	0.03	0.09
		Single Wraps	None	1.54	1.35	0.90	0.78	1.33	1.24	0.80	0.77	-0.21	-0.11	-0.10	-0.01
			Hurricane	1.19	1.00	0.71	0.62	1.16	1.05	0.74	0.71	-0.02	0.06	0.03	0.09
	B. (8d @ 6"/12")	Toe Nails	None	2.16	2.04	1.21	1.14	1.35	1.29	0.78	0.75	-0.81	-0.75	-0.42	-0.38
			Hurricane	1.04	0.92	0.76	0.69	0.96	0.89	0.71	0.69	-0.09	-0.03	-0.05	0.00
		Clips	None	1.00	0.83	0.76	0.64	1.00	0.93	0.74	0.71	0.01	0.10	-0.02	0.07
			Hurricane	0.81	0.66	0.64	0.55	0.89	0.83	0.71	0.67	0.09	0.17	0.07	0.13
		Single Wraps	None	0.95	0.76	0.76	0.64	0.96	0.88	0.74	0.71	0.01	0.12	-0.02	0.07
			Hurricane	0.76	0.64	0.64	0.55	0.89	0.82	0.71	0.67	0.14	0.18	0.07	0.13
	C. (8d @ 6"/6")	Toe Nails	None	2.16	2.04	1.21	1.16	1.35	1.29	0.78	0.75	-0.81	-0.75	-0.42	-0.41
			Hurricane	1.02	0.92	0.76	0.69	0.96	0.89	0.71	0.69	-0.06	-0.03	-0.05	0.00
		Clips	None	0.97	0.83	0.76	0.64	0.99	0.93	0.74	0.71	0.02	0.10	-0.02	0.07
			Hurricane	0.78	0.66	0.64	0.55	0.89	0.83	0.71	0.67	0.11	0.17	0.07	0.13
		Single Wraps	None	0.90	0.73	0.76	0.64	0.94	0.86	0.74	0.71	0.04	0.13	-0.02	0.07
			Hurricane	0.76	0.62	0.64	0.55	0.88	0.82	0.71	0.67	0.12	0.20	0.07	0.13
FBC Equivalent	A. (6d @ 6"/12")	Toe Nails	None	2.11	2.04	1.07	1.04	1.18	1.14	0.56	0.55	-0.93	-0.89	-0.50	-0.49
			Hurricane	1.02	1.00	0.59	0.57	0.77	0.77	0.45	0.45	-0.25	-0.23	-0.14	-0.11
		Clips	None	1.21	1.19	0.66	0.64	0.93	0.91	0.53	0.53	-0.28	-0.28	-0.13	-0.11
			Hurricane	0.88	0.83	0.50	0.47	0.74	0.72	0.45	0.45	-0.14	-0.11	-0.04	-0.02
		Single Wraps	None	1.21	1.19	0.66	0.64	0.89	0.89	0.53	0.53	-0.31	-0.29	-0.13	-0.11
			Hurricane	0.88	0.83	0.50	0.47	0.74	0.72	0.45	0.45	-0.14	-0.11	-0.04	-0.02
	B. (8d @ 6"/12")	Toe Nails	None	1.94	1.90	1.02	1.02	1.00	0.99	0.53	0.52	-0.94	-0.91	-0.49	-0.50
			Hurricane	0.81	0.78	0.57	0.55	0.60	0.58	0.45	0.44	-0.21	-0.20	-0.11	-0.11
		Clips	None	0.71	0.69	0.52	0.50	0.63	0.63	0.49	0.47	-0.08	-0.06	-0.04	-0.03
			Hurricane	0.55	0.52	0.43	0.40	0.53	0.52	0.44	0.44	-0.01	0.00	0.01	0.04
		Single Wraps	None	0.64	0.62	0.52	0.50	0.58	0.56	0.49	0.47	-0.06	-0.05	-0.04	-0.03
			Hurricane	0.52	0.47	0.43	0.40	0.52	0.52	0.44	0.44	0.00	0.04	0.01	0.04
	C. (8d @ 6"/6")	Toe Nails	None	1.94	1.90	1.02	1.02	1.00	0.99	0.53	0.52	-0.94	-0.91	-0.49	-0.50
			Hurricane	0.81	0.76	0.57	0.55	0.60	0.58	0.45	0.44	-0.21	-0.18	-0.11	-0.11
		Clips	None	0.71	0.66	0.52	0.50	0.63	0.61	0.49	0.47	-0.08	-0.05	-0.04	-0.03
			Hurricane	0.52	0.52	0.43	0.40	0.52	0.52	0.44	0.44	0.00	0.00	0.01	0.04
		Single Wraps	None	0.62	0.57	0.52	0.50	0.56	0.56	0.49	0.47	-0.05	0.00	-0.04	-0.03
			Hurricane	0.50	0.47	0.43	0.40	0.50	0.50	0.44	0.4391	0.00	0.03	0.01	0.04

Exhibit A-6: Terrain C Wind mitigation Relativities (2002 vs. 2008)]

Deductible 2% - Terrain C				Terrain C											
				2002 Credits in Comparable 2002:2008 Format				2008 Credits in Comparable 2002:2008 Format				2002-2008 Credits in Comp. 2002:2008 Format			
				Roof Shape				Roof Shape				Roof Shape			
				Other		Hip		Other		Hip		Other		Hip	
Roof Cover	Roof Deck Attachment	Roof-Wall Connection	Opening Protection	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR
Non-FBC Equivalent	A. (6d @ 6"/12")	Toe Nails	None	1.60	1.49	1.15	1.09	1.57	1.46	0.91	0.86	-0.03	-0.03	-0.24	-0.22
			Hurricane	0.98	0.83	0.58	0.45	0.97	0.85	0.53	0.49	0.00	0.02	-0.04	0.04
		Clips	None	1.31	1.18	0.90	0.78	1.32	1.21	0.80	0.75	0.01	0.02	-0.10	-0.03
			Hurricane	0.90	0.74	0.51	0.38	0.94	0.82	0.53	0.49	0.05	0.08	0.02	0.10
		Single Wraps	None	1.28	1.15	0.88	0.78	1.26	1.15	0.80	0.75	-0.02	-0.01	-0.08	-0.03
			Hurricane	0.90	0.74	0.51	0.38	0.94	0.82	0.53	0.49	0.05	0.08	0.02	0.10
	B. (8d @ 6"/12")	Toe Nails	None	1.46	1.38	1.14	1.07	1.37	1.27	0.86	0.82	-0.09	-0.10	-0.27	-0.26
			Hurricane	0.72	0.62	0.50	0.42	0.67	0.60	0.49	0.46	-0.05	-0.03	-0.01	0.04
		Clips	None	0.99	0.90	0.69	0.56	1.00	0.91	0.64	0.58	0.01	0.01	-0.04	0.02
			Hurricane	0.50	0.35	0.38	0.27	0.61	0.52	0.49	0.44	0.12	0.17	0.10	0.17
		Single Wraps	None	0.83	0.67	0.64	0.46	0.83	0.72	0.61	0.55	0.00	0.05	-0.03	0.09
			Hurricane	0.48	0.32	0.38	0.27	0.60	0.52	0.49	0.44	0.12	0.20	0.10	0.17
	C. (8d @ 6"/6")	Toe Nails	None	1.46	1.38	1.14	1.07	1.35	1.27	0.86	0.82	-0.11	-0.10	-0.27	-0.26
			Hurricane	0.70	0.62	0.50	0.42	0.66	0.60	0.49	0.46	-0.04	-0.03	-0.01	0.04
		Clips	None	0.98	0.88	0.69	0.56	0.99	0.91	0.64	0.58	0.01	0.03	-0.04	0.02
			Hurricane	0.46	0.34	0.38	0.27	0.60	0.52	0.49	0.44	0.13	0.18	0.10	0.17
		Single Wraps	None	0.82	0.64	0.62	0.43	0.80	0.71	0.60	0.53	-0.02	0.07	-0.03	0.10
			Hurricane	0.43	0.30	0.38	0.27	0.58	0.50	0.49	0.44	0.15	0.20	0.10	0.17
FBC Equivalent	A. (6d @ 6"/12")	Toe Nails	None	1.49	1.44	1.07	1.02	1.32	1.27	0.74	0.72	-0.17	-0.17	-0.33	-0.30
			Hurricane	0.82	0.77	0.43	0.40	0.67	0.66	0.35	0.35	-0.14	-0.11	-0.09	-0.05
		Clips	None	1.15	1.12	0.75	0.74	1.05	1.02	0.61	0.60	-0.10	-0.10	-0.14	-0.14
			Hurricane	0.70	0.67	0.35	0.32	0.64	0.63	0.35	0.35	-0.06	-0.04	-0.01	0.03
		Single Wraps	None	1.12	1.09	0.75	0.72	0.97	0.96	0.61	0.60	-0.15	-0.13	-0.14	-0.12
			Hurricane	0.70	0.66	0.35	0.32	0.64	0.63	0.35	0.35	-0.06	-0.03	-0.01	0.03
	B. (8d @ 6"/12")	Toe Nails	None	1.36	1.31	1.04	1.01	1.16	1.13	0.71	0.69	-0.20	-0.18	-0.33	-0.32
			Hurricane	0.59	0.58	0.38	0.35	0.44	0.44	0.31	0.31	-0.15	-0.14	-0.07	-0.04
		Clips	None	0.86	0.83	0.54	0.51	0.78	0.75	0.46	0.46	-0.08	-0.08	-0.09	-0.06
			Hurricane	0.35	0.30	0.26	0.22	0.38	0.36	0.31	0.30	0.02	0.06	0.06	0.07
		Single Wraps	None	0.67	0.62	0.46	0.42	0.58	0.56	0.41	0.41	-0.09	-0.06	-0.06	-0.01
			Hurricane	0.32	0.27	0.26	0.22	0.36	0.35	0.31	0.30	0.04	0.07	0.06	0.07
	C. (8d @ 6"/6")	Toe Nails	None	1.36	1.31	1.04	1.01	1.16	1.11	0.71	0.69	-0.20	-0.20	-0.33	-0.32
			Hurricane	0.59	0.56	0.38	0.35	0.44	0.42	0.31	0.31	-0.15	-0.14	-0.07	-0.04
		Clips	None	0.86	0.83	0.54	0.50	0.77	0.75	0.46	0.46	-0.10	-0.08	-0.09	-0.04
			Hurricane	0.32	0.29	0.26	0.22	0.36	0.36	0.31	0.30	0.04	0.07	0.06	0.07
		Single Wraps	None	0.64	0.59	0.45	0.38	0.56	0.55	0.41	0.41	-0.08	-0.04	-0.04	0.02
			Hurricane	0.29	0.26	0.26	0.22	0.35	0.35	0.31	0.2982	0.06	0.09	0.06	0.07

Exhibit A-7: Comparison of ARA 2002 and RMS wind mitigation relativity – Terrain B

Terrain B				2002 ARA				RMS				Difference			
				Roof Shape				Roof Shape				Roof Shape			
				Other		Hip		Other		Hip		Other		Hip	
Roof Cover	Roof Deck Attachment	Roof-Wall Attachment	Opening Protection	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR
Non-FBC Equivalent	A	Toe-Nails	None	2.37	2.22	1.26	1.18	3.18	0.00	2.07	0.00	-0.81		-0.81	
			Basic	1.53	1.37	0.91	0.83	2.64	0.00	1.44	0.00	-1.11		-0.53	
			Hurricane	1.33	1.15	0.80	0.71	2.34	0.00	1.24	0.00	-1.01		-0.44	
		Clips	None	1.55	1.37	0.91	0.80	2.49	0.00	1.35	0.00	-0.94		-0.44	
			Basic	1.26	1.08	0.75	0.65	1.73	0.00	0.92	0.00	-0.47		-0.17	
			Hurricane	1.19	1.01	0.72	0.61	1.50	0.00	0.79	0.00	-0.31		-0.07	
		Single Wraps	None	1.53	1.35	0.91	0.79	2.20	0.00	1.18	0.00	-0.67		-0.27	
			Basic	1.25	1.07	0.75	0.65	1.55	0.00	0.82	0.00	-0.30		-0.07	
			Hurricane	1.19	1.00	0.72	0.61	1.34	0.00	0.70	0.00	-0.15		0.02	
		Double Wraps	None	1.53	1.35	0.91	0.80	1.97	0.00	1.05	0.00	-0.44		-0.14	
			Basic	1.25	1.07	0.75	0.65	1.40	0.00	0.73	0.00	-0.15		0.02	
			Hurricane	1.19	1.00	0.72	0.61	1.21	0.00	0.62	0.00	-0.02		0.10	
	B	Toe-Nails	None	2.16	2.05	1.22	1.14	1.44	0.00	0.78	0.00	0.72		0.44	
			Basic	1.27	1.17	0.88	0.81	0.99	0.00	0.53	0.00	0.28		0.35	
			Hurricane	1.04	0.92	0.76	0.68	0.86	0.00	0.45	0.00	0.18		0.31	
		Clips	None	1.00	0.84	0.76	0.64	1.00	0.00	0.55	0.00	0.00		0.21	
			Basic	0.84	0.71	0.65	0.56	0.68	0.00	0.36	0.00	0.16		0.29	
			Hurricane	0.80	0.66	0.63	0.55	0.59	0.00	0.32	0.00	0.21		0.31	
		Single Wraps	None	0.95	0.76	0.75	0.64	0.87	0.00	0.48	0.00	0.08		0.27	
			Basic	0.79	0.64	0.64	0.55	0.60	0.00	0.32	0.00	0.19		0.32	
			Hurricane	0.77	0.63	0.63	0.55	0.52	0.00	0.29	0.00	0.25		0.34	
		Double Wraps	None	0.94	0.76	0.75	0.64	0.77	0.00	0.41	0.00	0.17		0.34	
			Basic	0.79	0.63	0.64	0.55	0.53	0.00	0.28	0.00	0.26		0.36	
			Hurricane	0.77	0.62	0.63	0.55	0.46	0.00	0.26	0.00	0.31		0.37	
	C	Toe-Nails	None	2.15	2.04	1.22	1.15	1.02	0.00	0.55	0.00	1.13		0.67	
			Basic	1.27	1.16	0.88	0.81	0.73	0.00	0.38	0.00	0.54		0.50	
			Hurricane	1.03	0.92	0.75	0.68	0.63	0.00	0.33	0.00	0.40		0.42	
		Clips	None	0.98	0.82	0.75	0.64	0.71	0.00	0.39	0.00	0.27		0.36	
			Basic	0.82	0.70	0.64	0.56	0.50	0.00	0.29	0.00	0.32		0.35	
			Hurricane	0.78	0.66	0.63	0.55	0.43	0.00	0.26	0.00	0.35		0.37	
		Single Wraps	None	0.91	0.73	0.75	0.63	0.63	0.00	0.34	0.00	0.28		0.41	
			Basic	0.77	0.63	0.64	0.55	0.45	0.00	0.27	0.00	0.32		0.37	
			Hurricane	0.75	0.62	0.63	0.55	0.40	0.00	0.25	0.00	0.35		0.38	
		Double Wraps	None	0.90	0.72	0.75	0.63	0.55	0.00	0.30	0.00	0.35		0.45	
			Basic	0.75	0.61	0.64	0.55	0.40	0.00	0.25	0.00	0.35		0.39	
			Hurricane	0.74	0.61	0.63	0.54	0.36	0.00	0.23	0.00	0.38		0.40	
FBC Equivalent	A	Toe-Nails	None	2.11	2.05	1.07	1.04	3.09	3.08	1.90	1.89	-0.98	-1.03	-0.83	-0.85
			Basic	1.26	1.22	0.71	0.69	2.45	2.44	1.31	1.30	-1.19	-1.22	-0.60	-0.61
			Hurricane	1.03	0.99	0.59	0.57	2.13	2.12	1.13	1.12	-1.10	-1.13	-0.54	-0.55
		Clips	None	1.22	1.19	0.67	0.65	2.29	2.28	1.24	1.23	-1.07	-1.09	-0.57	-0.58
			Basic	0.94	0.91	0.53	0.51	1.58	1.57	0.83	0.83	-0.64	-0.66	-0.30	-0.32
			Hurricane	0.88	0.84	0.49	0.47	1.36	1.35	0.71	0.71	-0.48	-0.51	-0.22	-0.24
		Single Wraps	None	1.21	1.18	0.67	0.65	2.01	2.00	1.08	1.08	-0.80	-0.82	-0.41	-0.43
			Basic	0.94	0.90	0.53	0.51	1.41	1.40	0.74	0.73	-0.47	-0.50	-0.21	-0.22
			Hurricane	0.87	0.84	0.49	0.47	1.22	1.21	0.63	0.63	-0.35	-0.37	-0.14	-0.16
		Double Wraps	None	1.21	1.17	0.67	0.65	1.81	1.80	0.96	0.95	-0.60	-0.63	-0.29	-0.30
			Basic	0.93	0.90	0.53	0.51	1.26	1.26	0.65	0.65	-0.33	-0.36	-0.12	-0.14
			Hurricane	0.87	0.83	0.49	0.47	1.09	1.08	0.56	0.56	-0.22	-0.25	-0.07	-0.09
	B	Toe-Nails	None	1.95	1.90	1.03	1.01	1.32	1.32	0.72	0.71	0.63	0.58	0.31	0.30
			Basic	1.06	1.02	0.69	0.67	0.90	0.89	0.47	0.47	0.16	0.13	0.22	0.20
			Hurricane	0.80	0.78	0.56	0.55	0.78	0.77	0.41	0.40	0.02	0.01	0.15	0.15
		Clips	None	0.72	0.69	0.53	0.50	0.92	0.92	0.51	0.50	-0.20	-0.23	0.02	0.00
			Basic	0.59	0.56	0.44	0.42	0.61	0.61	0.33	0.33	-0.02	-0.05	0.11	0.09
			Hurricane	0.54	0.51	0.43	0.41	0.53	0.53	0.29	0.29	0.01	-0.02	0.14	0.12
		Single Wraps	None	0.65	0.61	0.52	0.50	0.80	0.79	0.44	0.43	-0.15	-0.18	0.08	0.07
			Basic	0.53	0.49	0.43	0.41	0.54	0.54	0.29	0.29	-0.01	-0.05	0.14	0.12
			Hurricane	0.51	0.48	0.43	0.41	0.47	0.46	0.26	0.26	0.04	0.02	0.17	0.15
		Double Wraps	None	0.65	0.60	0.52	0.50	0.70	0.70	0.38	0.37	-0.05	-0.10	0.14	0.13
			Basic	0.52	0.48	0.43	0.41	0.47	0.47	0.26	0.26	0.05	0.01	0.17	0.15
			Hurricane	0.51	0.47	0.43	0.41	0.41	0.41	0.24	0.24	0.10	0.06	0.19	0.17
	C	Toe-Nails	None	1.94	1.89	1.03	1.01	0.92	0.92	0.49	0.49	1.02	0.97	0.54	0.52
			Basic	1.05	1.02	0.69	0.67	0.65	0.64	0.34	0.34	0.40	0.38	0.35	0.33
			Hurricane	0.80	0.77	0.56	0.55	0.56	0.56	0.30	0.30	0.24	0.21	0.26	0.25
		Clips	None	0.70	0.67	0.52	0.50	0.64	0.64	0.35	0.35	0.06	0.03	0.17	0.15
			Basic	0.58	0.55	0.44	0.42	0.44	0.44	0.26	0.26	0.14	0.11	0.18	0.16
			Hurricane	0.53	0.51	0.43	0.41	0.39	0.38	0.24	0.24	0.14	0.13	0.19	0.17
		Single Wraps	None	0.62	0.58	0.52	0.49	0.57	0.56	0.32	0.31	0.05	0.02	0.20	0.18
			Basic	0.51	0.48	0.43	0.41	0.40	0.40	0.25	0.25	0.11	0.08	0.18	0.16
			Hurricane	0.49	0.47	0.42	0.41	0.36	0.35	0.23	0.23	0.13	0.12	0.19	0.18
		Double Wraps	None	0.61	0.57	0.52	0.49	0.50	0.49	0.28	0.28	0.11	0.08	0.24	0.21
			Basic	0.50	0.46	0.43	0.41	0.36	0.35	0.23	0.23	0.14	0.11	0.20	0.18
			Hurricane	0.49	0.46	0.42	0.41	0.32	0.32	0.21	0.21	0.17	0.14	0.21	0.20

Exhibit A-8 Comparison of ARA and RMS Windstorm Mitigation Relativity – Terrain C

				Terrain C											
				2002 ARA				RMS				Difference			
				Roof Shape				Roof Shape				Roof Shape			
				Other		Hip		Other		Hip		Other		Hip	
Roof Cover	**Roof Deck Attachment**	**Roof-Wall Attachment**	**Opening Protection**	**No SWR**	**SWR**	**No SWR**	**SWR**	**No SWR**	**SWR**	**No SWR**	**SWR**	**No SWR**	**SWR**	**No SWR**	**SWR**
Non-FBC Equivalent	A	Toe-Nails	None	1.60	1.49	1.16	1.09	2.59	0.00	1.73	0.00	-0.99		-0.57	
			Basic	1.13	0.99	0.71	0.61	2.04	0.00	1.18	0.00	-0.91		-0.47	
			Hurricane	0.98	0.83	0.57	0.45	1.80	0.00	1.02	0.00	-0.82		-0.45	
		Clips	None	1.31	1.19	0.89	0.79	2.11	0.00	1.23	0.00	-0.80		-0.34	
			Basic	0.99	0.83	0.58	0.45	1.43	0.00	0.83	0.00	-0.44		-0.25	
			Hurricane	0.90	0.73	0.51	0.38	1.24	0.00	0.72	0.00	-0.34		-0.21	
		Single Wraps	None	1.28	1.15	0.88	0.78	1.84	0.00	1.07	0.00	-0.56		-0.19	
			Basic	0.97	0.81	0.58	0.45	1.26	0.00	0.73	0.00	-0.29		-0.15	
			Hurricane	0.90	0.73	0.51	0.38	1.10	0.00	0.63	0.00	-0.20		-0.12	
		Double Wraps	None	1.27	1.15	0.88	0.78	1.63	0.00	0.94	0.00	-0.36		-0.06	
			Basic	0.97	0.81	0.58	0.45	1.12	0.00	0.64	0.00	-0.15		-0.06	
			Hurricane	0.90	0.73	0.51	0.38	0.98	0.00	0.56	0.00	-0.08		-0.05	
	B	Toe-Nails	None	1.46	1.37	1.13	1.07	1.32	0.00	0.79	0.00	0.14		0.34	
			Basic	0.89	0.80	0.65	0.58	0.89	0.00	0.53	0.00	0.00		0.12	
			Hurricane	0.72	0.62	0.50	0.42	0.78	0.00	0.47	0.00	-0.06		0.03	
		Clips	None	1.00	0.89	0.69	0.56	1.00	0.00	0.62	0.00	0.00		0.07	
			Basic	0.60	0.47	0.43	0.33	0.67	0.00	0.42	0.00	-0.07		0.01	
			Hurricane	0.49	0.35	0.39	0.28	0.59	0.00	0.37	0.00	-0.10		0.02	
		Single Wraps	None	0.84	0.68	0.64	0.47	0.87	0.00	0.54	0.00	-0.03		0.10	
			Basic	0.53	0.38	0.41	0.30	0.59	0.00	0.37	0.00	-0.06		0.04	
			Hurricane	0.48	0.32	0.38	0.28	0.52	0.00	0.34	0.00	-0.04		0.04	
		Double Wraps	None	0.79	0.59	0.63	0.45	0.76	0.00	0.47	0.00	0.03		0.16	
			Basic	0.51	0.34	0.41	0.29	0.52	0.00	0.33	0.00	-0.01		0.08	
			Hurricane	0.47	0.31	0.38	0.27	0.46	0.00	0.30	0.00	0.01		0.08	
	C	Toe-Nails	None	1.45	1.37	1.13	1.07	0.93	0.00	0.56	0.00	0.52		0.57	
			Basic	0.88	0.79	0.65	0.58	0.65	0.00	0.40	0.00	0.23		0.25	
			Hurricane	0.71	0.62	0.50	0.42	0.57	0.00	0.35	0.00	0.14		0.15	
		Clips	None	0.98	0.88	0.69	0.56	0.72	0.00	0.45	0.00	0.26		0.24	
			Basic	0.57	0.46	0.43	0.33	0.50	0.00	0.34	0.00	0.07		0.09	
			Hurricane	0.46	0.34	0.38	0.28	0.44	0.00	0.31	0.00	0.02		0.07	
		Single Wraps	None	0.81	0.64	0.63	0.44	0.63	0.00	0.40	0.00	0.18		0.23	
			Basic	0.49	0.36	0.40	0.29	0.45	0.00	0.31	0.00	0.04		0.09	
			Hurricane	0.43	0.30	0.38	0.27	0.40	0.00	0.29	0.00	0.03		0.09	
		Double Wraps	None	0.72	0.47	0.62	0.41	0.55	0.00	0.35	0.00	0.17		0.27	
			Basic	0.45	0.30	0.39	0.27	0.40	0.00	0.29	0.00	0.05		0.10	
			Hurricane	0.42	0.28	0.37	0.26	0.36	0.00	0.27	0.00	0.06		0.10	
FBC Equivalent	A	Toe-Nails	None	1.49	1.44	1.07	1.03	2.54	2.53	1.63	1.62	-1.05	-1.09	-0.56	-0.59
			Basic	0.97	0.93	0.59	0.56	1.93	1.92	1.10	1.09	-0.96	-0.99	-0.51	-0.53
			Hurricane	0.81	0.77	0.43	0.40	1.68	1.67	0.95	0.95	-0.87	-0.90	-0.52	-0.55
		Clips	None	1.16	1.12	0.75	0.73	1.99	1.98	1.16	1.16	-0.83	-0.86	-0.41	-0.43
			Basic	0.80	0.76	0.43	0.39	1.34	1.33	0.78	0.77	-0.54	-0.57	-0.35	-0.38
			Hurricane	0.71	0.67	0.36	0.32	1.16	1.16	0.68	0.67	-0.45	-0.49	-0.32	-0.35
		Single Wraps	None	1.12	1.09	0.75	0.72	1.73	1.72	1.01	1.00	-0.61	-0.63	-0.26	-0.28
			Basic	0.79	0.74	0.43	0.39	1.18	1.17	0.68	0.68	-0.39	-0.43	-0.25	-0.29
			Hurricane	0.71	0.66	0.36	0.32	1.02	1.02	0.59	0.59	-0.31	-0.36	-0.23	-0.27
		Double Wraps	None	1.12	1.08	0.75	0.72	1.53	1.53	0.89	0.88	-0.41	-0.45	-0.14	-0.16
			Basic	0.78	0.74	0.43	0.39	1.04	1.04	0.60	0.60	-0.26	-0.30	-0.17	-0.21
			Hurricane	0.71	0.66	0.36	0.32	0.91	0.90	0.52	0.52	-0.20	-0.24	-0.16	-0.20
	B	Toe-Nails	None	1.36	1.32	1.04	1.01	1.25	1.25	0.75	0.75	0.11	0.07	0.29	0.26
			Basic	0.78	0.75	0.55	0.53	0.84	0.83	0.50	0.50	-0.06	-0.08	0.05	0.03
			Hurricane	0.60	0.57	0.38	0.36	0.73	0.73	0.44	0.44	-0.13	-0.16	-0.06	-0.08
		Clips	None	0.87	0.84	0.54	0.51	0.95	0.95	0.59	0.59	-0.08	-0.11	-0.05	-0.08
			Basic	0.46	0.42	0.31	0.28	0.64	0.64	0.40	0.40	-0.18	-0.22	-0.09	-0.12
			Hurricane	0.35	0.30	0.26	0.23	0.56	0.56	0.36	0.36	-0.21	-0.26	-0.10	-0.13
		Single Wraps	None	0.68	0.63	0.46	0.41	0.82	0.82	0.51	0.51	-0.14	-0.19	-0.05	-0.10
			Basic	0.38	0.33	0.28	0.24	0.56	0.56	0.36	0.36	-0.18	-0.23	-0.08	-0.12
			Hurricane	0.32	0.27	0.26	0.22	0.49	0.49	0.32	0.32	-0.17	-0.22	-0.06	-0.10
		Double Wraps	None	0.60	0.53	0.45	0.39	0.72	0.72	0.45	0.44	-0.12	-0.19	0.00	-0.05
			Basic	0.35	0.29	0.27	0.23	0.49	0.49	0.32	0.31	-0.14	-0.20	-0.05	-0.08
			Hurricane	0.32	0.26	0.25	0.22	0.43	0.43	0.29	0.29	-0.11	-0.17	-0.04	-0.07
	C	Toe-Nails	None	1.36	1.32	1.04	1.01	0.88	0.88	0.54	0.53	0.48	0.44	0.50	0.48
			Basic	0.78	0.74	0.55	0.53	0.61	0.61	0.37	0.37	0.17	0.13	0.18	0.16
			Hurricane	0.59	0.56	0.39	0.36	0.54	0.53	0.34	0.34	0.05	0.03	0.05	0.02
		Clips	None	0.86	0.83	0.54	0.50	0.68	0.68	0.43	0.43	0.18	0.15	0.11	0.07
			Basic	0.44	0.41	0.30	0.27	0.47	0.47	0.33	0.32	-0.03	-0.06	-0.03	-0.05
			Hurricane	0.32	0.29	0.26	0.23	0.42	0.42	0.30	0.30	-0.10	-0.13	-0.04	-0.07
		Single Wraps	None	0.64	0.59	0.45	0.39	0.60	0.60	0.39	0.39	0.04	-0.01	0.06	0.00
			Basic	0.35	0.31	0.27	0.23	0.42	0.42	0.30	0.30	-0.07	-0.11	-0.03	-0.07
			Hurricane	0.29	0.25	0.25	0.22	0.38	0.38	0.28	0.28	-0.09	-0.13	-0.03	-0.06
		Double Wraps	None	0.51	0.41	0.43	0.36	0.52	0.52	0.34	0.34	-0.01	-0.11	0.09	0.02
			Basic	0.30	0.25	0.26	0.22	0.37	0.37	0.28	0.28	-0.07	-0.12	-0.02	-0.06
			Hurricane	0.28	0.23	0.25	0.21	0.34	0.34	0.26	0.26	-0.06	-0.11	-0.01	-0.05

Note that the RMS model does not have an option for Secondary Water Resistance with Non-FBC approved roof coverings because the SWR concept was introduced around the same time as the FBC roofing (2001) making it impossible to have SWR with old roofing materials

Exhibit A-9: Comparison of ARA 2002 and RMS wind mitigation credits – Terrain B

				Terrain B											
				ARA				RMS				Difference			
				Roof Shape				Roof Shape				Roof Shape			
				Other		Hip		Other		Hip		Other		Hip	
Roof Cover	**Roof Deck Attachment**	**Roof-Wall Attachment**	**Opening Protection**	**No SWR**	**SWR**	**No SWR**	**SWR**	**No SWR**	**SWR**	**No SWR**	**SWR**	**No SWR**	**SWR**	**No SWR**	**SWR**
Non-FBC Equivalent	A	Toe-Nails	None	0.00	0.06	0.47	0.50	0.00		0.35		0.00		0.12	
			Basic	0.35	0.42	0.62	0.65	0.17		0.55		0.18		0.07	
			Hurricane	0.44	0.51	0.66	0.70	0.26		0.61		0.17		0.05	
		Clips	None	0.35	0.42	0.62	0.66	0.22		0.58		0.13		0.04	
			Basic	0.47	0.54	0.68	0.73	0.46		0.71		0.01		-0.03	
			Hurricane	0.50	0.57	0.70	0.74	0.53		0.75		-0.03		-0.06	
		Single Wraps	None	0.35	0.43	0.62	0.67	0.31		0.63		0.05		-0.01	
			Basic	0.47	0.55	0.68	0.73	0.51		0.74		-0.04		-0.06	
			Hurricane	0.50	0.58	0.70	0.74	0.58		0.78		-0.08		-0.08	
		Double Wraps	None	0.35	0.43	0.62	0.66	0.38		0.67		-0.02		-0.05	
			Basic	0.47	0.55	0.68	0.73	0.56		0.77		-0.09		-0.09	
			Hurricane	0.50	0.58	0.70	0.74	0.62		0.80		-0.12		-0.11	
	B	Toe-Nails	None	0.09	0.14	0.49	0.52	0.55		0.75		-0.46		-0.27	
			Basic	0.46	0.51	0.63	0.66	0.69		0.83		-0.22		-0.21	
			Hurricane	0.56	0.61	0.68	0.71	0.73		0.86		-0.17		-0.18	
		Clips	None	0.58	0.65	0.68	0.73	0.69		0.83		-0.11		-0.15	
			Basic	0.65	0.70	0.73	0.76	0.79		0.89		-0.14		-0.16	
			Hurricane	0.66	0.72	0.73	0.77	0.82		0.90		-0.15		-0.17	
		Single Wraps	None	0.60	0.68	0.68	0.73	0.73		0.85		-0.13		-0.17	
			Basic	0.67	0.73	0.73	0.77	0.81		0.90		-0.14		-0.17	
			Hurricane	0.68	0.73	0.73	0.77	0.84		0.91		-0.16		-0.18	
		Double Wraps	None	0.60	0.68	0.68	0.73	0.76		0.87		-0.16		-0.19	
			Basic	0.67	0.73	0.73	0.77	0.83		0.91		-0.17		-0.18	
			Hurricane	0.68	0.74	0.73	0.77	0.86		0.92		-0.18		-0.18	
	C	Toe-Nails	None	0.09	0.14	0.49	0.51	0.68		0.83		-0.59		-0.34	
			Basic	0.46	0.51	0.63	0.66	0.77		0.88		-0.31		-0.25	
			Hurricane	0.57	0.61	0.68	0.71	0.80		0.89		-0.24		-0.21	
		Clips	None	0.59	0.65	0.68	0.73	0.78		0.88		-0.19		-0.19	
			Basic	0.65	0.70	0.73	0.76	0.84		0.91		-0.19		-0.18	
			Hurricane	0.67	0.72	0.73	0.77	0.86		0.92		-0.19		-0.18	
		Single Wraps	None	0.62	0.69	0.68	0.73	0.80		0.89		-0.19		-0.21	
			Basic	0.68	0.73	0.73	0.77	0.86		0.91		-0.18		-0.18	
			Hurricane	0.68	0.74	0.73	0.77	0.87		0.92		-0.19		-0.19	
		Double Wraps	None	0.62	0.70	0.68	0.73	0.83		0.90		-0.21		-0.22	
			Basic	0.68	0.74	0.73	0.77	0.87		0.92		-0.19		-0.19	
			Hurricane	0.69	0.74	0.73	0.77	0.89		0.93		-0.20		-0.19	
FBC Equivalent	A	Toe-Nails	None	0.11	0.14	0.55	0.56	0.03	0.03	0.40	0.41	0.08	0.10	0.15	0.15
			Basic	0.47	0.49	0.70	0.71	0.23	0.23	0.59	0.59	0.24	0.25	0.11	0.12
			Hurricane	0.57	0.58	0.75	0.76	0.33	0.33	0.65	0.65	0.23	0.25	0.11	0.11
		Clips	None	0.49	0.50	0.72	0.73	0.28	0.28	0.61	0.61	0.21	0.22	0.11	0.11
			Basic	0.60	0.62	0.78	0.78	0.50	0.51	0.74	0.74	0.10	0.11	0.04	0.05
			Hurricane	0.63	0.65	0.79	0.80	0.57	0.57	0.78	0.78	0.06	0.07	0.02	0.02
		Single Wraps	None	0.49	0.50	0.72	0.73	0.37	0.37	0.66	0.66	0.12	0.13	0.06	0.06
			Basic	0.60	0.62	0.78	0.78	0.56	0.56	0.77	0.77	0.05	0.06	0.01	0.01
			Hurricane	0.63	0.65	0.79	0.80	0.62	0.62	0.80	0.80	0.02	0.03	-0.01	0.00
		Double Wraps	None	0.49	0.51	0.72	0.73	0.43	0.44	0.70	0.70	0.06	0.07	0.02	0.03
			Basic	0.61	0.62	0.78	0.78	0.60	0.61	0.79	0.80	0.01	0.02	-0.02	-0.01
			Hurricane	0.63	0.65	0.79	0.80	0.66	0.66	0.82	0.83	-0.02	-0.01	-0.03	-0.02
	B	Toe-Nails	None	0.18	0.20	0.57	0.57	0.58	0.59	0.77	0.78	-0.41	-0.39	-0.21	-0.20
			Basic	0.55	0.57	0.71	0.72	0.72	0.72	0.85	0.85	-0.16	-0.15	-0.14	-0.13
			Hurricane	0.66	0.67	0.76	0.77	0.76	0.76	0.87	0.87	-0.09	-0.09	-0.11	-0.10
		Clips	None	0.70	0.71	0.78	0.79	0.71	0.71	0.84	0.84	-0.01	0.00	-0.06	-0.05
			Basic	0.75	0.76	0.81	0.82	0.81	0.81	0.90	0.90	-0.06	-0.04	-0.08	-0.07
			Hurricane	0.77	0.78	0.82	0.83	0.83	0.83	0.91	0.91	-0.06	-0.05	-0.09	-0.08
		Single Wraps	None	0.73	0.74	0.78	0.79	0.75	0.75	0.86	0.86	-0.02	-0.01	-0.08	-0.07
			Basic	0.78	0.79	0.82	0.83	0.83	0.83	0.91	0.91	-0.05	-0.04	-0.09	-0.08
			Hurricane	0.78	0.80	0.82	0.83	0.85	0.85	0.92	0.92	-0.07	-0.06	-0.10	-0.09
		Double Wraps	None	0.73	0.75	0.78	0.79	0.78	0.78	0.88	0.88	-0.05	-0.03	-0.10	-0.09
			Basic	0.78	0.80	0.82	0.83	0.85	0.85	0.92	0.92	-0.07	-0.05	-0.10	-0.09
			Hurricane	0.78	0.80	0.82	0.83	0.87	0.87	0.93	0.93	-0.09	-0.07	-0.11	-0.10
	C	Toe-Nails	None	0.18	0.20	0.57	0.57	0.71	0.71	0.84	0.85	-0.53	-0.51	-0.28	-0.27
			Basic	0.56	0.57	0.71	0.72	0.80	0.80	0.89	0.89	-0.24	-0.23	-0.18	-0.18
			Hurricane	0.66	0.68	0.76	0.77	0.82	0.82	0.91	0.91	-0.16	-0.15	-0.14	-0.14
		Clips	None	0.70	0.72	0.78	0.79	0.80	0.80	0.89	0.89	-0.09	-0.08	-0.11	-0.10
			Basic	0.76	0.77	0.81	0.82	0.86	0.86	0.92	0.92	-0.10	-0.09	-0.10	-0.09
			Hurricane	0.78	0.78	0.82	0.83	0.88	0.88	0.92	0.92	-0.10	-0.09	-0.10	-0.10
		Single Wraps	None	0.74	0.76	0.78	0.79	0.82	0.82	0.90	0.90	-0.08	-0.07	-0.12	-0.11
			Basic	0.78	0.80	0.82	0.83	0.87	0.88	0.92	0.92	-0.09	-0.08	-0.10	-0.10
			Hurricane	0.79	0.80	0.82	0.83	0.89	0.89	0.93	0.93	-0.09	-0.09	-0.10	-0.10
		Double Wraps	None	0.74	0.76	0.78	0.79	0.84	0.85	0.91	0.91	-0.10	-0.09	-0.13	-0.12
			Basic	0.79	0.81	0.82	0.83	0.89	0.89	0.93	0.93	-0.10	-0.08	-0.11	-0.10
			Hurricane	0.79	0.81	0.82	0.83	0.90	0.90	0.93	0.93	-0.11	-0.09	-0.11	-0.11

Exhibit A-10: Comparison of ARA 2002 and RMS wind mitigation credits – Terrain C

Terrain C															
				ARA				RMS				Difference			
				Roof Shape				Roof Shape				Roof Shape			
				Other		Hip		Other		Hip		Other		Hip	
Roof Cover	Roof Deck Attachment	Roof-Wall Attachment	Opening Protection	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR	No SWR	SWR
Non-FBC Equivalent	A	Toe-Nails	None	0.00	0.07	0.28	0.32	0.00		0.33		0.00		-0.05	
			Basic	0.29	0.38	0.56	0.62	0.21		0.54		0.08		0.01	
			Hurricane	0.39	0.48	0.64	0.72	0.30		0.60		0.08		0.04	
		Clips	None	0.18	0.26	0.44	0.51	0.18		0.52		0.00		-0.08	
			Basic	0.38	0.48	0.64	0.72	0.45		0.68		-0.07		-0.04	
			Hurricane	0.44	0.54	0.68	0.76	0.52		0.72		-0.08		-0.04	
		Single Wraps	None	0.20	0.28	0.45	0.51	0.29		0.59		-0.09		-0.14	
			Basic	0.39	0.49	0.64	0.72	0.51		0.72		-0.12		-0.08	
			Hurricane	0.44	0.54	0.68	0.76	0.58		0.75		-0.14		-0.07	
		Double Wraps	None	0.21	0.28	0.45	0.51	0.37		0.64		-0.16		-0.19	
			Basic	0.39	0.49	0.64	0.72	0.57		0.75		-0.17		-0.11	
			Hurricane	0.44	0.54	0.68	0.76	0.62		0.78		-0.18		-0.10	
	B	Toe-Nails	None	0.09	0.14	0.29	0.33	0.49		0.70		-0.40		-0.40	
			Basic	0.44	0.50	0.59	0.64	0.66		0.79		-0.21		-0.20	
			Hurricane	0.55	0.61	0.69	0.74	0.70		0.82		-0.15		-0.13	
		Clips	None	0.38	0.44	0.57	0.65	0.61		0.76		-0.24		-0.19	
			Basic	0.63	0.71	0.73	0.79	0.74		0.84		-0.11		-0.11	
			Hurricane	0.69	0.78	0.76	0.83	0.77		0.86		-0.08		-0.10	
		Single Wraps	None	0.48	0.58	0.60	0.71	0.66		0.79		-0.19		-0.19	
			Basic	0.67	0.76	0.74	0.81	0.77		0.86		-0.10		-0.11	
			Hurricane	0.70	0.80	0.76	0.83	0.80		0.87		-0.10		-0.11	
		Double Wraps	None	0.51	0.63	0.61	0.72	0.71		0.82		-0.20		-0.21	
			Basic	0.68	0.79	0.74	0.82	0.80		0.87		-0.12		-0.13	
			Hurricane	0.71	0.81	0.76	0.83	0.82		0.88		-0.12		-0.12	
	C	Toe-Nails	None	0.09	0.14	0.29	0.33	0.64		0.78		-0.55		-0.49	
			Basic	0.45	0.51	0.59	0.64	0.75		0.85		-0.30		-0.25	
			Hurricane	0.56	0.61	0.69	0.74	0.78		0.86		-0.22		-0.18	
		Clips	None	0.39	0.45	0.57	0.65	0.72		0.83		-0.34		-0.26	
			Basic	0.64	0.71	0.73	0.79	0.81		0.87		-0.16		-0.14	
			Hurricane	0.71	0.79	0.76	0.83	0.83		0.88		-0.12		-0.12	
		Single Wraps	None	0.49	0.60	0.61	0.73	0.76		0.84		-0.26		-0.24	
			Basic	0.69	0.78	0.75	0.82	0.83		0.88		-0.13		-0.13	
			Hurricane	0.73	0.81	0.76	0.83	0.84		0.89		-0.11		-0.12	
		Double Wraps	None	0.55	0.71	0.61	0.74	0.79		0.86		-0.24		-0.25	
			Basic	0.72	0.81	0.76	0.83	0.85		0.89		-0.13		-0.13	
			Hurricane	0.74	0.83	0.77	0.84	0.86		0.90		-0.12		-0.13	
FBC Equivalent	A	Toe-Nails	None	0.07	0.10	0.33	0.36	0.02	0.02	0.37	0.37	0.05	0.08	-0.04	-0.02
			Basic	0.39	0.42	0.63	0.65	0.25	0.26	0.58	0.58	0.14	0.16	0.06	0.07
			Hurricane	0.49	0.52	0.73	0.75	0.35	0.35	0.63	0.63	0.14	0.16	0.10	0.12
		Clips	None	0.28	0.30	0.53	0.54	0.23	0.23	0.55	0.55	0.04	0.07	-0.02	-0.01
			Basic	0.50	0.53	0.73	0.76	0.48	0.49	0.70	0.70	0.02	0.04	0.03	0.06
			Hurricane	0.56	0.58	0.78	0.80	0.55	0.55	0.74	0.74	0.01	0.03	0.04	0.06
		Single Wraps	None	0.30	0.32	0.53	0.55	0.33	0.33	0.61	0.61	-0.03	-0.02	-0.08	-0.06
			Basic	0.51	0.54	0.73	0.76	0.55	0.55	0.74	0.74	-0.04	-0.01	-0.01	0.02
			Hurricane	0.56	0.59	0.78	0.80	0.60	0.61	0.77	0.77	-0.05	-0.02	0.00	0.03
		Double Wraps	None	0.30	0.33	0.53	0.55	0.41	0.41	0.66	0.66	-0.11	-0.09	-0.13	-0.11
			Basic	0.51	0.54	0.73	0.76	0.60	0.60	0.77	0.77	-0.08	-0.06	-0.04	-0.01
			Hurricane	0.56	0.59	0.78	0.80	0.65	0.65	0.80	0.80	-0.09	-0.06	-0.02	0.00
	B	Toe-Nails	None	0.15	0.18	0.35	0.37	0.52	0.52	0.71	0.71	-0.37	-0.34	-0.36	-0.34
			Basic	0.51	0.53	0.66	0.67	0.68	0.68	0.81	0.81	-0.16	-0.15	-0.15	-0.14
			Hurricane	0.63	0.64	0.76	0.78	0.72	0.72	0.83	0.83	-0.09	-0.07	-0.07	-0.05
		Clips	None	0.46	0.48	0.66	0.68	0.63	0.63	0.77	0.77	-0.18	-0.16	-0.11	-0.09
			Basic	0.71	0.74	0.81	0.83	0.75	0.75	0.84	0.84	-0.04	-0.02	-0.04	-0.02
			Hurricane	0.78	0.81	0.84	0.86	0.78	0.78	0.86	0.86	0.00	0.03	-0.02	0.00
		Single Wraps	None	0.58	0.61	0.71	0.74	0.68	0.68	0.80	0.80	-0.11	-0.08	-0.09	-0.06
			Basic	0.76	0.79	0.83	0.85	0.78	0.78	0.86	0.86	-0.02	0.01	-0.04	-0.01
			Hurricane	0.80	0.83	0.84	0.86	0.81	0.81	0.87	0.87	-0.01	0.02	-0.04	-0.01
		Double Wraps	None	0.63	0.67	0.72	0.76	0.72	0.72	0.83	0.83	-0.10	-0.05	-0.11	-0.07
			Basic	0.78	0.82	0.83	0.86	0.81	0.81	0.88	0.88	-0.03	0.01	-0.05	-0.02
			Hurricane	0.80	0.84	0.84	0.86	0.83	0.83	0.89	0.89	-0.03	0.00	-0.04	-0.03
	C	Toe-Nails	None	0.15	0.18	0.35	0.37	0.66	0.66	0.79	0.79	-0.51	-0.49	-0.44	-0.43
			Basic	0.51	0.54	0.66	0.67	0.76	0.77	0.86	0.86	-0.25	-0.23	-0.20	-0.19
			Hurricane	0.63	0.65	0.76	0.78	0.79	0.79	0.87	0.87	-0.16	-0.14	-0.11	-0.10
		Clips	None	0.46	0.48	0.66	0.69	0.74	0.74	0.83	0.83	-0.27	-0.26	-0.17	-0.15
			Basic	0.73	0.74	0.81	0.83	0.82	0.82	0.87	0.87	-0.09	-0.07	-0.06	-0.04
			Hurricane	0.80	0.82	0.84	0.86	0.84	0.84	0.88	0.88	-0.04	-0.02	-0.05	-0.03
		Single Wraps	None	0.60	0.63	0.72	0.76	0.77	0.77	0.85	0.85	-0.17	-0.14	-0.13	-0.09
			Basic	0.78	0.81	0.83	0.86	0.84	0.84	0.88	0.88	-0.06	-0.03	-0.05	-0.03
			Hurricane	0.82	0.84	0.84	0.86	0.85	0.85	0.89	0.89	-0.03	-0.01	-0.05	-0.03
		Double Wraps	None	0.68	0.74	0.73	0.78	0.80	0.80	0.87	0.87	-0.12	-0.06	-0.14	-0.09
			Basic	0.81	0.84	0.84	0.86	0.86	0.86	0.89	0.89	-0.04	-0.01	-0.06	-0.03
			Hurricane	0.83	0.86	0.84	0.87	0.87	0.87	0.90	0.90	-0.04	-0.01	-0.06	-0.03

Exhibit A-11: Windstorm Mitigation Credits adopted in March 2007 (Form OIR-B1-1699) [104]

WINDSTORM LOSS REDUCTION CREDITS
SECTION 627.0629(1), F.S.
WIND PREMIUM CREDITS FOR EXISTING CONSTRUCTION

				TERRAIN B - 2% DEDUCTIBLE				TERRAIN C - 2% DEDUCTIBLE			
				FRAME, MASONRY, OR REINFORCED MASONRY							
				ROOF SHAPE				ROOF SHAPE			
				OTHER		HIP		OTHER		HIP	
ROOF COVER	ROOF DECK ATTACHMENT	ROOF-WALL CONNECTION	OPENING PROTECTION	NO SWR	SWR	NO SWR	SWR	NO SWR	SWR	NO SWR	SWR
			None	0.00	0.06	0.47	0.50	0.00	0.07	0.28	0.32
		TOE NAILS	Basic - Windows or All	0.35	0.42	0.62	0.65	0.29	0.38	0.56	0.62
			Hurricane - Windows or All	0.44	0.51	0.66	0.70	0.39	0.48	0.64	0.72
			None	0.35	0.42	0.62	0.66	0.18	0.26	0.44	0.51
		CLIPS	Basic - Windows or All	0.47	0.54	0.68	0.73	0.38	0.48	0.64	0.72
NON - FBC	A		Hurricane - Windows or All	0.50	0.57	0.70	0.74	0.44	0.54	0.68	0.76
EQUIVALENT	(6d @ 6" / 12")		None	0.35	0.43	0.62	0.67	0.20	0.28	0.45	0.51
		SINGLE WRAPS	Basic - Windows or All	0.47	0.55	0.68	0.73	0.39	0.49	0.64	0.72
			Hurricane - Windows or All	0.50	0.58	0.70	0.74	0.44	0.54	0.68	0.76
			None	0.35	0.43	0.62	0.66	0.21	0.28	0.45	0.51
		DOUBLE WRAPS	Basic - Windows or All	0.47	0.55	0.68	0.73	0.39	0.49	0.64	0.72
			Hurricane - Windows or All	0.50	0.58	0.70	0.74	0.44	0.54	0.68	0.76
			None	0.09	0.14	0.49	0.52	0.09	0.14	0.29	0.33
		TOE NAILS	Basic - Windows or All	0.46	0.51	0.63	0.66	0.44	0.50	0.59	0.64
			Hurricane - Windows or All	0.56	0.61	0.68	0.71	0.55	0.61	0.69	0.74
			None	0.58	0.65	0.68	0.73	0.38	0.44	0.57	0.65
		CLIPS	Basic - Windows or All	0.65	0.70	0.73	0.76	0.63	0.71	0.73	0.79
NON - FBC	B		Hurricane - Windows or All	0.66	0.72	0.73	0.77	0.69	0.78	0.76	0.83
EQUIVALENT	(8d @ 6" / 12")		None	0.60	0.68	0.68	0.73	0.48	0.58	0.60	0.71
		SINGLE WRAPS	Basic - Windows or All	0.67	0.73	0.73	0.77	0.67	0.76	0.74	0.81
			Hurricane - Windows or All	0.68	0.73	0.73	0.77	0.70	0.80	0.76	0.83
			None	0.60	0.68	0.68	0.73	0.51	0.63	0.61	0.72
		DOUBLE WRAPS	Basic - Windows or All	0.67	0.73	0.73	0.77	0.68	0.79	0.74	0.82
			Hurricane - Windows or All	0.68	0.74	0.73	0.77	0.71	0.81	0.76	0.83
			None	0.09	0.14	0.49	0.51	0.09	0.14	0.29	0.33
	C	TOE NAILS	Basic - Windows or All	0.46	0.51	0.63	0.66	0.45	0.51	0.59	0.64
	(8d @ 6" / 6")		Hurricane - Windows or All	0.57	0.61	0.68	0.71	0.56	0.61	0.69	0.74
			None	0.59	0.65	0.68	0.73	0.39	0.45	0.57	0.65
	AND	CLIPS	Basic - Windows or All	0.65	0.70	0.73	0.76	0.64	0.71	0.73	0.79
NON - FBC			Hurricane - Windows or All	0.67	0.72	0.73	0.77	0.71	0.79	0.76	0.83
EQUIVALENT	D		None	0.62	0.69	0.68	0.73	0.49	0.60	0.61	0.73
	(8d @ 6" / 6")	SINGLE WRAPS	Basic - Windows or All	0.68	0.73	0.73	0.77	0.69	0.78	0.75	0.82
	DIMENSIONAL		Hurricane - Windows or All	0.68	0.74	0.73	0.77	0.73	0.81	0.76	0.83
	LUMBER		None	0.62	0.70	0.68	0.73	0.55	0.71	0.61	0.74
	DECK	DOUBLE WRAPS	Basic - Windows or All	0.68	0.74	0.73	0.77	0.72	0.81	0.76	0.83
			Hurricane - Windows or All	0.69	0.74	0.73	0.77	0.74	0.83	0.77	0.84
			None	0.11	0.14	0.55	0.56	0.07	0.10	0.33	0.36
		TOE NAILS	Basic - Windows or All	0.47	0.49	0.70	0.71	0.39	0.42	0.63	0.65
			Hurricane - Windows or All	0.57	0.58	0.75	0.76	0.49	0.52	0.73	0.75
			None	0.49	0.50	0.72	0.73	0.28	0.30	0.53	0.54
		CLIPS	Basic - Windows or All	0.60	0.62	0.78	0.78	0.50	0.53	0.73	0.76
FBC	A		Hurricane - Windows or All	0.63	0.65	0.79	0.80	0.56	0.58	0.78	0.80
EQUIVALENT	(6d @ 6" / 12")		None	0.49	0.50	0.72	0.73	0.30	0.32	0.53	0.55
		SINGLE WRAPS	Basic - Windows or All	0.60	0.62	0.78	0.78	0.51	0.54	0.73	0.76
			Hurricane - Windows or All	0.63	0.65	0.79	0.80	0.56	0.59	0.78	0.80
			None	0.49	0.51	0.72	0.73	0.30	0.33	0.53	0.55
		DOUBLE WRAPS	Basic - Windows or All	0.61	0.62	0.78	0.78	0.51	0.54	0.73	0.76
			Hurricane - Windows or All	0.63	0.65	0.79	0.80	0.56	0.59	0.78	0.80
			None	0.18	0.20	0.57	0.57	0.15	0.18	0.35	0.37
		TOE NAILS	Basic - Windows or All	0.55	0.57	0.71	0.72	0.51	0.53	0.66	0.67
			Hurricane - Windows or All	0.66	0.67	0.76	0.77	0.63	0.64	0.76	0.78
			None	0.70	0.71	0.78	0.79	0.46	0.48	0.66	0.68
		CLIPS	Basic - Windows or All	0.75	0.76	0.81	0.82	0.71	0.74	0.81	0.83
FBC	B		Hurricane - Windows or All	0.77	0.78	0.82	0.83	0.78	0.81	0.84	0.86
EQUIVALENT	(8d @ 6" / 12")		None	0.73	0.74	0.78	0.79	0.58	0.61	0.71	0.74
		SINGLE WRAPS	Basic - Windows or All	0.78	0.79	0.82	0.83	0.76	0.79	0.83	0.85
			Hurricane - Windows or All	0.78	0.80	0.82	0.83	0.80	0.83	0.84	0.86
			None	0.73	0.75	0.78	0.79	0.63	0.67	0.72	0.76
		DOUBLE WRAPS	Basic - Windows or All	0.78	0.80	0.82	0.83	0.78	0.82	0.83	0.86
			Hurricane - Windows or All	0.78	0.80	0.82	0.83	0.80	0.84	0.84	0.86
			None	0.18	0.20	0.57	0.57	0.15	0.18	0.35	0.37
	C	TOE NAILS	Basic - Windows or All	0.56	0.57	0.71	0.72	0.51	0.54	0.66	0.67
	(8d @ 6" / 6")		Hurricane - Windows or All	0.66	0.68	0.76	0.77	0.63	0.65	0.76	0.78
			None	0.70	0.72	0.78	0.79	0.46	0.48	0.66	0.69
	AND	CLIPS	Basic - Windows or All	0.76	0.77	0.81	0.82	0.73	0.74	0.81	0.83
FBC			Hurricane - Windows or All	0.78	0.78	0.82	0.83	0.80	0.82	0.84	0.86
EQUIVALENT	D		None	0.74	0.76	0.78	0.79	0.60	0.63	0.72	0.76
	(8d @ 6" / 6")	SINGLE WRAPS	Basic - Windows or All	0.78	0.80	0.82	0.83	0.78	0.81	0.83	0.86
	DIMENSIONAL		Hurricane - Windows or All	0.79	0.80	0.82	0.83	0.82	0.84	0.84	0.86
	LUMBER		None	0.74	0.76	0.78	0.79	0.68	0.74	0.73	0.78
	DECK	DOUBLE WRAPS	Basic - Windows or All	0.79	0.81	0.82	0.83	0.81	0.84	0.84	0.86
			Hurricane - Windows or All	0.79	0.81	0.82	0.83	0.83	0.86	0.84	0.87
			None				0.82				0.80
REINFORCED CONCRETE ROOF DECK			Basic - Windows or All				0.84				0.88
			Hurricane - Windows or All				0.84				0.88

APPENDIX B: DATA, METHODOLOGY, RELIANCES, ASSUMPTIONS, AND DISCLOSURES.

The data, methodology and assumptions used were described in the appropriate sections of this report. We relied on publicly available information where noted, as well as on the sources listed in the references and in footnotes. We assumed that all data and information received was complete and accurate at the time it was gathered. Although reasonability checks and comparison to alternate sources were performed where practicable, we did not independently verify any data used.

The methodologies employed were selected for the purposes of responding to the referenced RFP in an objective, multi-disciplinary manner. Modified and simplifying assumptions and algorithms were used as jointly determined to be appropriate by the authors, with reliance on each individual in areas related, but not limited to, their areas of expertise.

Every effort has been made to provide full and complete disclosure of the data, methods, and assumptions used throughout this report, while retaining a level of explanation that is useful for the intended audience. Additional information, except for those areas deemed to be RMS proprietary or trade secret, can be made available for review and discussion as appropriate.

The conclusions and implications of this report and the analyses are specific to the task at hand and are not meant to be used out of the context of the full report or for other purposes.

No attempt has been made to evaluate the performance, practices, rate adequacy, or financial position of any company or entity doing business or involved in the insurance industry in the state of Florida. Rather, the analysis is focused on the market as a whole and subsections that may be materially impacted by the implementation of the wind mitigation credits have been identified.

QUASR (Quarterly and Supplemental Reporting System) and QUASRng

Public reports were requested from QUASRng (Q1 2009 and forward) and QUASR. Insurers doing business in the state of Florida are required by § 624.424 (10), Florida Statutes to report statistical information to the Florida Office of Insurance Regulation (OIR) in conjunction with their quarterly financial reports.

QUASR was originally intended to track non-renewals of policies following Hurricane Andrew. The information is focused on policies written, cancelled and non-renewed by county in order to audit the moratorium requirements. QUASR has been revised and updated over the years, with additional scrutiny and automatic quality checks being incorporated. Since QUASR was developed as a tracking tool under an emergency situation and is not relied upon for rate information, its usefulness is more limited and the data it contains has not been subject to the same level of scrutiny. Therefore, outside information was relied upon to verify information derived from QUASR and I-File information was used where possible.

Table 26: Region designations by county as defined by the FCHLPM

County Code	County	Region	Location
001	ALACHUA	Central	Inland
003	BAKER	North	Inland
005	BAY	North	Coastal
007	BRADFORD	North	Inland
009	BREVARD	Central	Coastal
011	BROWARD	South	Coastal
013	CALHOUN	North	Inland
015	CHARLOTTE	South	Coastal
017	CITRUS	Central	Coastal
019	CLAY	North	Inland
021	COLLIER	South	Coastal
023	COLUMBIA	North	Inland
027	DESOTO	Central	Inland
029	DIXIE	Central	Coastal
031	DUVAL	North	Coastal
033	ESCAMBIA	North	Coastal
035	FLAGLER	Central	Coastal
037	FRANKLIN	North	Coastal
039	GADSDEN	North	Inland
041	GILCHRIST	Central	Inland
043	GLADES	South	Inland
045	GULF	North	Coastal
047	HAMILTON	North	Inland
049	HARDEE	Central	Inland
051	HENDRY	South	Inland
053	HERNANDO	Central	Coastal
055	HIGHLANDS	Central	Inland
057	HILLSBOROUGH	Central	Coastal
059	HOLMES	North	Inland
061	INDIANRIVER	Central	Coastal
063	JACKSON	North	Inland
065	JEFFERSON	North	Coastal
067	LAFAYETTE	North	Inland
069	LAKE	Central	Inland
071	LEE	South	Coastal
073	LEON	North	Inland
075	LEVY	Central	Coastal
077	LIBERTY	North	Inland
079	MADISON	North	Inland
081	MANATEE	Central	Coastal
083	MARION	Central	Inland
085	MARTIN	South	Coastal
086	MIAMIDADE	South	Coastal
087	MONROE	South	Coastal
089	NASSAU	North	Coastal
091	OKALOOSA	North	Coastal
093	OKEECHOBEE	Central	Inland
095	ORANGE	Central	Inland
097	OSCEOLA	Central	Inland
099	PALMBEACH	South	Coastal
101	PASCO	Central	Coastal
103	PINELLAS	Central	Coastal
105	POLK	Central	Inland
107	PUTNAM	Central	Inland
109	STJOHNS	Central	Coastal
111	STLUCIE	Central	Coastal
113	SANTAROSA	North	Coastal
115	SARASOTA	South	Coastal
117	SEMINOLE	Central	Inland
119	SUMTER	Central	Inland
121	SUWANNEE	North	Inland
123	TAYLOR	North	Coastal
125	UNION	North	Inland
127	VOLUSIA	Central	Coastal
129	WAKULLA	North	Coastal
131	WALTON	North	Coastal
133	WASHINGTON	North	Inland

I-FILE System

https://iportal.fldfs.com/ifile/default.asp

Certain required sections of the rate filings submitted by companies were of interest. They are the Rate Indication Form (RIF) and the rating examples. A blank RIF is shown below Figure 29. Columns 6 through 49 were reviewed for programs most closely aligned with the single family homes being analyzed. Figure 30 shows a rating example sheet and the risk descriptions are in Figure 30. The rating examples are in the Rate Collection System, which is a subset of I-File.

STATE OF FLORIDA -- OFFICE OF INSURANCE REGULATION
HO/MHO/DF STANDARDIZED RATE INDICATIONS WORKBOOK

STATE EXHIBIT 1
SHEET 1

RATE INDICATIONS

GROUP NAME:	ABC Ins. Group
PRODUCT TYPE:	Homeowners
PRODUCT SUB-TYPE	N/A
STATE:	Florida Experience Only

PROGRAM NAME:	Ultra-Preferred*
POLICY TYPE:	HO-2+HO-3*
COMPANY(IES):	XINS+XIND*

(A) Loss Experience Eval. Date:	03/31/08
(B) Annual Premium Trend:	0.0%
(C) Annual Loss Trend (Up-to-Date):	0.0%
(D) Annual Loss Trend (Projected):	0.0%
(E) Avg. Acc. Date for Proj. Rates:	01/01/10

PREMIUMS:

(1) Accident Year Ending	(2) Months of Maturity	(3) Earned House-Years	(4) Written Premiums ($000's)	(5) Earned Premiums ($000's)	(6) Current Rate Level Factors (SUPPORT!)	(7) Premium Trend Factors	(8) Trended Earned Premiums at C.R.L. ($000's)
12/31/2003	63	10,000	$10,000	$10,000	1.000	1.000	$10,000
12/31/2004	51	10,000	10,000	10,000	1.000	1.000	10,000
12/31/2005	39					1.000	0
12/31/2006	27					1.000	0
12/31/2007	15					1.000	0
TOTAL		20,000	$20,000	$20,000			$20,000

NOTES:

ACTUAL LOSSES:

(1) Accident Year Ending	(9) ACTUAL INCURRED LOSSES ($000's) Incl. Cats.	(10) Non-Hurr. Cat.	(11) Hurricane Cat.	(12) Excl. Cats.	(13) ACTUAL INCURRED ALAE ($000's) Incl. Cats.	(14) Non-Hurr. Cat.	(15) Hurricane Cat.	(16) Excl. Cats.	(17) INCURRED ULAE ($000's) Incl. Cats. (SUPPORT!)	(18) Non-Hurr. Cat. (SUPPORT!)	(19) Hurricane Cat. (SUPPORT!)	(20) Excl. Cats.	(21) Actual Incurred Loss & LAE Excl. Cats. ($000's)
12/31/2003	$5,000	$0	$0	$5,000	$1,000	$0	$0	$1,000	$1,000	$0	$0	$1,000	$7,000
12/31/2004	5,000	0	0	5,000	1,000	0	0	1,000	1,000	0	0	1,000	7,000
12/31/2005				0				0				0	0
12/31/2006				0				0				0	0
12/31/2007				0				0				0	0
TOTAL	$10,000	$0	$0	$10,000	$2,000	$0	$0	$2,000	$2,000	$0	$0	$2,000	$14,000

PROJECTED CATASTROPHE LOSSES:

(1) Accident Year Ending	(22) ---PROJECTED NON-HURR. CAT ($000's)--- Losses (SUPPORT!)	(23) ALAE (SUPPORT!)	(24) ULAE (SUPPORT!)	(25) Losses & ALAE & ULAE
12/31/2003	$0	$0	$0	$0
12/31/2004	0	0	0	$0
12/31/2005				$0
12/31/2006				$0
12/31/2007				$0
TOTAL	$0	$0	$0	$0

--- POLICY IN-FORCE DATA --- INSERT APPLICABLE DATE IN YELLOW HIGHLIGHTED CELL ---

(26) POLICIES IN-FORCE ALL POLICIES	(27) POLICIES IN-FORCE WIND ONLY POLICIES	(28) PREMIUM IN-FORCE AT C.R.L. ($000's) ALL POLICIES (SUPPORT!)	(29) PREMIUM IN-FORCE AT C.R.L. ($000's) WIND ONLY POLICIES (SUPPORT!)	(30) Projected HURRICANE Losses ($000's) (SUPPORT!)	(31) Projected HURRICANE ALAE ($000's) (SUPPORT!)	(32) Projected HURRICANE ULAE ($000's) (SUPPORT!)	(33) Projected HURRICANE Loss & LAE ($000's)
-	-	$0	$0	$0	$0	$0	$0

DEVELOPMENT OF PROJECTED LOSS & LAE RATIO:

(1) Accident Year Ending	(34) Actual Incurred Loss & LAE Excl. Cats. ($000's)	(35) Loss & ALAE Develop-ment Factors (SUPPORT!)	(36) Loss Trend Factors	(37) Trended & Developed Incurred Loss & LAE Excl. Cats. ($000's)
12/31/2003	$7,000	1.000	1.000	$7,000
12/31/2004	7,000	1.000	1.000	7,000
12/31/2005	0		1.000	0
12/31/2006	0		1.000	0
12/31/2007	0		1.000	0
TOTAL	$14,000			$14,000

(1) Accident Year Ending	(38) Projected Incurred Loss & LAE Incl. Non-Hurr Cat ($000's)	(39) Bad Faith/ Punitive Damage Loss & ALAE Incl. in (34) ($000's)	(40) Projected Incurred Loss & LAE Incl. Non-Hurr Cat. Excl. BF/PD ($000's)	(41) Adjustment Factor for Law Changes, Etc. (SUPPORT!)	(42) Final Adjusted Expected Incurred Loss & LAE ($000's)	(43) Projected Incurred Loss & LAE Ratio Incl. Non-Hurr Cat ($000's)	(44) Selected Accident Year Weights (SUPPORT!)	(45) Weighted Proj. Incurred Loss & LAE Incl. Non-Hurr Cat Excl. BF/PD
12/31/2003	$7,000	$0	$7,000	1.000	$7,000	70.0%	50.0%	
12/31/2004	$7,000	0	7,000	1.000	7,000	70.0%	50.0%	
12/31/2005	$0		0		0	0.0%		
12/31/2006	$0		0		0	0.0%		
12/31/2007	$0		0		0	0.0%		
TOTAL	$14,000	$0	$14,000		$14,000	70.0%	100.0%	70.0%

PROSPECTIVE EXPENSE PROVISIONS (% OF PREMIUM):

(46) Category of Expected Expense	(47) Fixed Expense Loading * (SUPPORT!)	(48) Variable Expense Loading (SUPPORT!)	(49) Total Expense Loading
Commissions	0.0%	0.0%	0.0%
Other Acquisition	0.0%	0.0%	0.0%
General	0.0%	0.0%	0.0%
Premium Taxes	0.0%	0.0%	0.0%
Misc. Licenses & Fees	0.0%	0.0%	0.0%
Profit & Contingency	0.0%	0.0%	0.0%
Contingent Commissions	0.0%	0.0%	0.0%
Non-FHCF Reins. Cost	0.0%	0.0%	0.0%
FHCF Reins. Cost	0.0%	0.0%	0.0%
Other Expense (Specify**)	0.0%	0.0%	0.0%
TOTAL EXPENSES	0.0%	0.0%	0.0%
PERMISSIBLE LOSS & LAE			100.0%

* - Must reflect trend and/or other adjustments since last filing
** - (Specify in detail here)

DEVELOPMENT OF RATE LEVEL INDICATIONS:

(50)	0.0%	Projected Hurricane Loss & LAE ratio
(51)	70.0%	Proj. Incurred Loss & LAE Ratio (Incl. all catastrophes)
(52)	0.0%	Expected Fixed Expense Ratio
(53)	0.0%	Expected Variable Expense Ratio
(54)	**-30.0%**	**Rate Level Indication (Before Credibility)**
(55)	0.50	Credibility (SUPPORT!)
(56)	0.0%	Expected Annual Net Trend (i.e., Projected Loss Trend Net of Premium Trend)
(57)	1.00	Assumed Number of Years Since Last Rate Review
(58)	0.0%	Expected Net Trend Since Last Rate Review (Value receives complement of credibility)
(59)	**-15.0%**	**Credibility-Weighted Rate Level Indication**
(60)	**0.0%**	**Company Selected Rate Change**

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Created by: Florida OIR

03/19/10

Figure 29: Blank RIF from OIR I-File

OIR IFILE Rating Examples

Rating Example Report

Policy Type	Owners	Risk Type	Rating Example Description		Masonry structure insured for replacement cost at $300,000 with a 2% Hurricane Deductible and structures insured at 10% of the amount of insurance on the structure; Contents insured for repla Loss of Use insured at 20% of the amount of insurance on the structure; $100,000 Liability cover provided at 25% of the amount of insurance on the structure; I.S.O. Protection Class 4; I.S.O. HO NEW BUSINESS for a 40 YEAR OLD INSURED with NO CLAIMS IN THE PAST 3 YEARS and a and does NOT have a hip roof. Sinkhole coverage is included with a $500 deductible. Screened or mold coverage cannot be excluded, it should be noted under Risk Difference that the coverage recoupment that should be included in the rate is the Florida Hurricane Catastrophe Fund reimbu		
Company Name			Company A	Company B	Company C	Company D	Company E
Market Share			2%	2%	3%	7%	2%
NAIC Group Code			1344	1344	8		
File Log Number			09-20777	09-20777	09-14529	09-17343	08-09909
Program Name			HOMEOWNERS (HO)	HOMEOWNERS (HO)	HOMEOWNERS (HO)	PERSONAL LINES ACCOUNT HO (HO)	Elite HO
Effective New Date			12/1/2009	12/1/2009	9/14/2009	1/1/2010	8/15/2008
Effective Renewal Date			2/1/2010	2/1/2010	11/8/2009	1/1/2010	8/15/2008
Region Name			Rate	Rate	Rate	Rate	Rate
Alachua			$207.00	$207.00	$162.00	$370.00	$285.00
Baker			$192.00	$192.00	$145.00	$394.00	$362.00
Bay			$798.50	$798.50	$538.50	$1,628.50	$1,150.00
Bradford			$192.00	$192.00	$133.00	$398.00	$362.00
Brevard			$902.00	$902.00	$545.50	$1,481.00	$963.00
Broward			$2,269.67	$2,269.67	$1,659.33	$2,787.67	$1,415.67

Page 1 $300K NEW CONST HURRICANE

Figure 30: I-File rating example. There are three pages for each example, hurricane, non-hurricane, and total.

Rating Examples:

New Construction

Masonry structure insured for replacement cost at $300,000 with a 2% Hurricane Deductible and a $500 deductible for all other Section I perils combined; Other structures insured at 10% of the amount of insurance on the structure; Contents insured for replacement cost at 50% of the amount of insurance on the structure; Loss of Use insured at 20% of the amount of insurance on the structure; $100,000 Liability coverage; $1,000 Medical expense; Ordinance or law coverage provided at 25% of the amount of insurance on the structure; I.S.O. Protection Class 4; I.S.O. HO-3 POLICY TYPE. The rates should be ANNUAL RATES for NEW BUSINESS for a 40 YEAR OLD INSURED with NO CLAIMS IN THE PAST 3 YEARS and a NEUTRAL CREDIT SCORE. The structure was built in 2005 and does NOT have a hip roof. Sinkhole coverage is included with a $500 deductible. Screened enclosure and mold coverage are excluded. (If screened enclosure or mold coverage cannot be excluded, it should be noted under Risk Difference that the coverage is included and the associated limit provided.) The ONLY recoupment that should be included in the rate is the Florida Hurricane Catastrophe Fund reimbursement premium recoupment, if applicable.

Pre-2001 Construction with no mitigation features

Masonry structure insured for replacement cost at $300,000 with a 2% Hurricane Deductible and a $500 deductible for all other Section I perils combined; Other structures insured at 10% of the amount of insurance on the structure; Contents insured for replacement cost at 50% of the amount of insurance on the structure; Loss of Use insured at 20% of the amount of insurance on the structure; $100,000 Liability coverage; $1,000 Medical expense; Ordinance or law coverage provided at 25% of the amount of insurance on the structure; I.S.O. Protection Class 4; I.S.O. HO-3 POLICY

TYPE. The rates should be ANNUAL RATES for NEW BUSINESS for a 40 YEAR OLD INSURED with NO CLAIMS IN THE PAST 3 YEARS and a NEUTRAL CREDIT SCORE. The structure was built in 1990 and does NOT have a hip roof. Sinkhole coverage is included with a $500 deductible. Screened enclosure and mold coverage are excluded. (If screened enclosure or mold coverage cannot be excluded, it should be noted under Risk Difference that the coverage is included and the associated limit provided.) The ONLY recoupment that should be included in the rate is the Florida Hurricane Catastrophe Fund reimbursement premium recoupment, if applicable.

Pre-2001 Construction with “maximum” mitigation features

Masonry structure insured for replacement cost at $300,000 with a 2% Hurricane Deductible and a $500 deductible for all other Section I perils combined; Other structures insured at 10% of the amount of insurance on the structure; Contents insured for replacement cost at 50% of the amount of insurance on the structure; Loss of Use insured at 20% of the amount of insurance on the structure; $100,000 Liability coverage; $1,000 Medical expense; Ordinance or law coverage provided at 25% of the amount of insurance on the structure; I.S.O. Protection Class 4; I.S.O. HO-3 POLICY TYPE. The rates should be ANNUAL RATES for NEW BUSINESS for a 40 YEAR OLD INSURED with NO CLAIMS IN THE PAST 3 YEARS and a NEUTRAL CREDIT SCORE. The structure was built in 1990 and does NOT have a hip roof. Include the maximum possible windstorm loss mitigation credit for this risk. Sinkhole coverage is included with a $500 deductible. Screened enclosure and mold coverage are excluded. (If screened enclosure or mold coverage cannot be excluded, it should be noted under Risk Difference that the coverage is included and the associated limit provided.) The ONLY recoupment that should be included in the rate is the Florida Hurricane Catastrophe Fund reimbursement premium recoupment, if applicable.

I-File Rate Filings reviewed

RMS requested from OIR[20] a list of the most recently approved homeowners rate filings with expense allocation information and rate examples for the top writers in the state. The filings in the list were reviewed and relevant information extracted to guide the selections. The filings reviewed cover approximately 66% of the voluntary homeowners premium in the state. Where there is more than one filing listed, the first filing number is the one OIR recommended and the second was also reviewed

Table 27: List of company rate filings referenced in this project

Company Name	Filing
AMERICAN STRATEGIC INSURANCE CORP.	09-20777 & 08-01249
ASI ASSURANCE CORP.	09-20777 & 08-01250
CASTLE KEY INSURANCE COMPANY	09-14529
FLORIDA PENINSULA INSURANCE COMPANY	08-09909
HOMEOWNERS CHOICE PROPERTY & CASUALTY INSURANCE COMPANY	08-01612
HOMEWISE INSURANCE COMPANY, INC.	09-06199
HOMEWISE PREFERRED INSURANCE COMPANY	09-06199
LIBERTY MUTUAL FIRE INSURANCE COMPANY	09-17087
MAGNOLIA INSURANCE COMPANY	08-19556
NATIONWIDE INSURANCE COMPANY OF FLORIDA	09-03248
ROYAL PALM INSURANCE COMPANY	09-08445
ST. JOHNS INSURANCE COMPANY, INC.	09-16899
STATE FARM FLORIDA INSURANCE COMPANY	09-23564

[20] RMS would like to thank Ken Ritzenthaler of the OIR for the assistance provided in compiling some of the public data used in this analysis.

Company Name	Filing
TOWER HILL PRIME INSURANCE COMPANY	09-20855
UNITED PROPERTY & CASUALTY INSURANCE COMPANY, INC.	09-22363
UNITED SERVICES AUTOMOBILE ASSOCIATION	09-23288
UNIVERSAL INSURANCE COMPANY OF NORTH AMERICA	09-17647
UNIVERSAL PROPERTY & CASUALTY INSURANCE COMPANY	09-13685
USAA CASUALTY INSURANCE COMPANY	09-23288

Development of the Hybrid Database

RMS created a hybrid exposure data set of the entire Florida building stock by combining the MSFH portfolio with the RMS® U.S. Industry Exposure Database (IED). Specifically, RMS merged the homes in the MSFH program portfolio—approximately 400,000 individual locations representing about 10% of Florida single-family dwellings—with the Florida residential building stock in the RMS® U.S. IED, containing approximately 1,000 aggregate locations which represent the 4.9 million homes that constitute the Florida residential building stock.

IED Characteristics

The RMS® U.S. IED consists of aggregate exposures at the ZIP Code level of geographic resolution and is a representation of insured property exposure by line of business in the U.S. Using proprietary RMS data, the IED exposures for the approximate 1,000 ZIP Codes in Florida were divided into 114,000 locations, representing classes of structures by size of living area, roof shape, roof cover, roof anchor, opening protection, and year of construction. In order to perform this disaggregation, RMS utilized its ExposureSource database, and the inventory data that forms a basis of the vulnerability module of the RMS® U.S. Hurricane Model. The inventory data in the RMS model assumes a distribution for the number of stories, and other attributes of structures throughout Florida, such as roof shape, shutter usage, and construction class. The ExposureSource database contains over 60 million residential locations and 10 million commercial and industrial properties from a variety of third party data sources, field surveys, and remote sensing work that can be used to judge the data quality and completeness of insurance data sets. It contains tax record information on nearly every property in the state of Florida, and has been used to create an explicit distribution of square footage or living area and year built within the aggregate portfolio.

To account for the differences in the characteristics of exposure data sets, the IED portion of the exposure set must be adjusted to offset the distributions of characteristics found in the MSFH data. For example, the MSFH portfolio contains wind-specific risk information on almost 400,000 locations in Florida, including roof cover, roof shape, roof deck, construction, year built, opening protection, and roof anchors. The MSFH exposure data exhibits a greater proportion of wind-resistive characteristics than the general building stock. This means that the straight incorporation of the MSFH data into the hybrid exposure set would result in a slight bias toward lower statewide loss results. To compensate, the disaggregated IED portion of the hybrid database must contain the complement of the wind-resistive features so that the average across the hybrid exposure set remains the same as the statewide average. This was accomplished using additional data sources and extensive research to ensure that the resulting hybrid exposure data set represents the range of wind risk attributes found throughout all locations in the state. A baseline analysis on this hybrid exposure set was conducted, measuring the risk associated with the current building stock.

Thus, the hybrid exposure data set combines the detailed location-specific information of the MSFH portfolio with the comprehensive aggregate location information.

MSFH Characteristics

In the creation of the hybrid exposure data set, it is assumed that building values in the MSFH portfolio represent replacement cost value of the building only, excluding land. Note that building values were collected from each homeowner applicant, and thus may include land value. There was a tendency for the aggregated MSFH building values in some ZIP Codes to exceed the aggregate values in the IED. However, this was generally less than 2% of the total state value and thus does not affect this analysis. When no value associated with contents or time element insurance coverages was found for locations in the MSFH portfolio, contents value is assumed to be 50% of the building value and additional living expense (ALE) coverage is valued at 10% of the building replacement cost

Deductible amounts, supplied by homeowner applicants in the MSFH portfolio at the time of the inspection, were utilized in this exposure set. Any inconsistencies in data were treated with reasonable assumptions. For example, a 2% deductible was assumed if no other information was supplied; similarly, structures were assumed to be one story if no information was provided.

Moreover, the living area of a home was estimated using the plan area collected by the inspector and the known or assumed number of stories. Living area, denoted in square footage, is a key parameter in properly analyzing a structure's susceptibility to risk.

Removal of Citizens

One of the goals of this report was to examine how the wind mitigation credits may impact a typical insurance company. The hybrid exposure set, as described above, represents the entire residential building stock in the state of Florida, including exposure insured by Florida Citizens Property Insurance Corporation. Since Citizens is not a typical company and has specific requirements for its rates, it was excluded so that impacts on the voluntary market could be more realistically examined. The exposure was removed using an aggregate form of the December 2008 Citizens data, to remove their residential exposure from the hybrid data set.

Table 28: Hybrid exposure set with and without citizens

	Total Insured Value ($)	Number of Buildings
Hybrid Exposure Set Including Citizens	2,060,547,790,971	4,974,823
Hybrid Exposure Set Less Citizens	1,874,516,332,733	4,439,461
Difference (% Diff)	186,031,458,238 (9.0%)	535,362 (10.8%)

Key Characteristics in the Hybrid Data Set

Figure 31 shows the distributions of some of the key characteristics in the Hybrid Data Set. These include: the number of stories, the size of the living area, the year of construction, the roof cover system, the presence of roof anchors, the roof deck construction (e.g., nail size/spacing), and the presence of any window protection.

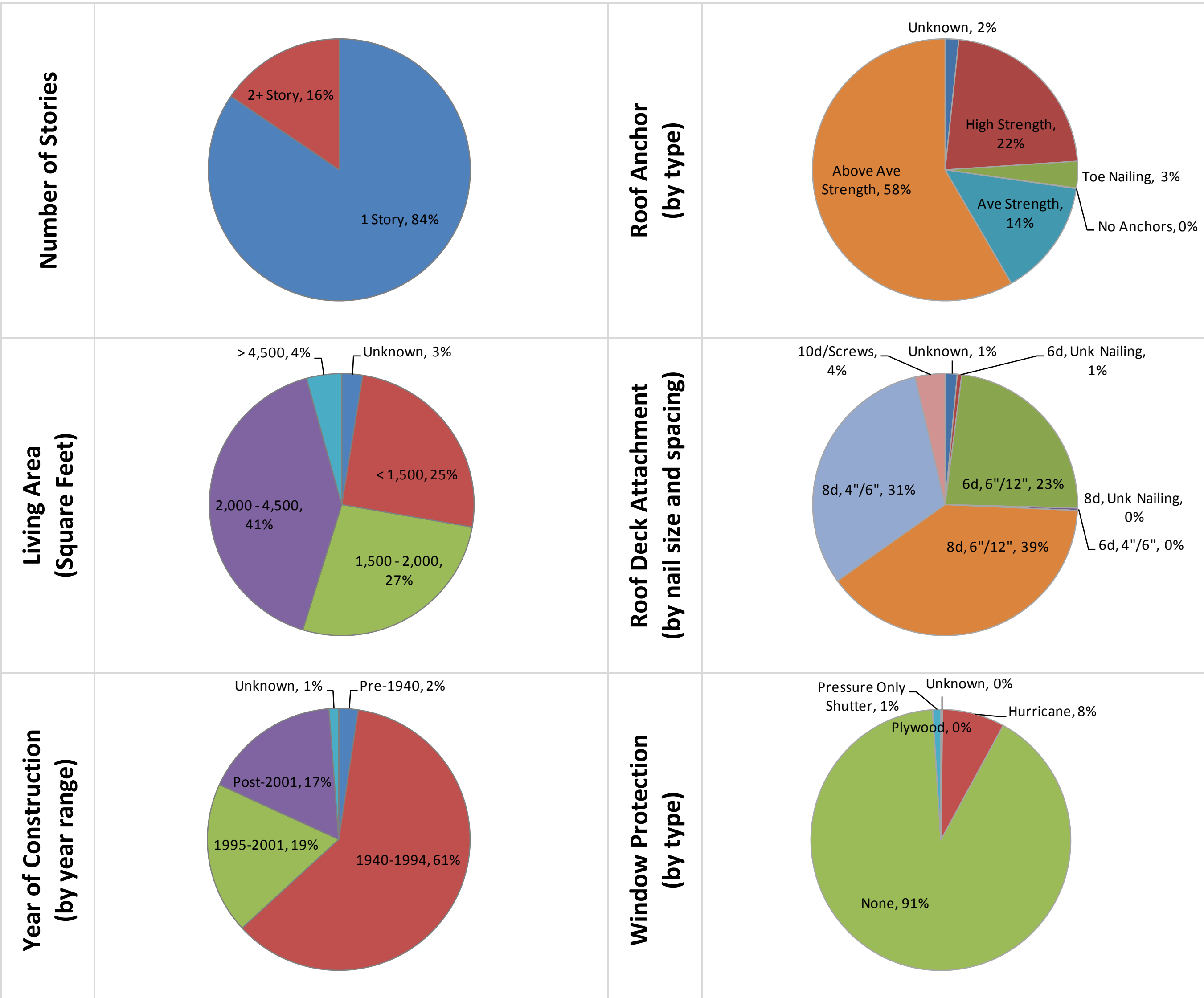

Figure 31: Distribution of key parameters of hybrid data sets

FHCF Info

Table 29: 2008 Reported Exposures as of 3/5/09: Source - "FHCF 2009 Ratemaking Formula Report to the SBA of FL, March 20, 2009"

2009 Ratemaking Formula Report 2008 Reported Exposures as of 3/5/09 Residential Totals By Mitigation Features					
Mitigation Feature	**Units**	**Percent of Units**	**Primary Exposure**	**Average Exposure**	**Percent of Exposure**
YEAR BUILT					
Unknown or Mobile Home	157,086	3.48%	$34,863,206,217	$221,937	1.96%
1994 or Earlier	2,924,534	64.78%	$1,014,259,291,792	$346,811	56.98%
1995-2001	630,433	13.96%	$314,396,448,079	$498,699	17.66%
2002 or Later	802,382	17.77%	$416,524,617,323	$519,110	23.40%
TOTAL	4,514,435	100.00%	$1,780,043,563,411	$1,586,557	100.00%
FLORIDA BUILDING CODE INDICATOR					
Meets 2002 FL Building Code	855,217	18.94%	$428,051,069,405	$500,517	24.05%
Does Not Meet FL Building Code or is Unknown	3,659,218	81.06%	$1,351,992,494,006	$369,476	75.95%
TOTAL	4,514,435	100.00%	$1,780,043,563,411	$869,993	100.00%
STRUCTURE OPENING PROTECTION					
None or Unknown	3,985,022	88.27%	$1,483,083,214,084	$372,164	83.32%
Basic Shutters	106,551	2.36%	$48,136,059,793	$451,765	2.70%
Hurricane or Engineered Shutters or FBC-Equivalent	422,862	9.37%	$248,824,289,534	$588,429	13.98%
TOTAL	4,514,435	100.00%	$1,780,043,563,411	$1,412,359	100.00%
ROOF SHAPE					
Hip, Mansard, or Pyramid	905,550	20.06%	$482,068,817,454	$532,349	27.08%
Gable, Other, or Unknown	3,608,885	79.94%	$1,297,974,745,957	$359,661	72.92%
TOTAL	4,514,435	100.00%	$1,780,043,563,411	$892,010	100.00%
ROOF-WALL CONNECTION					
Anchor Bolts, Hurricane Ties, Clips, Single Wraps, Double Wraps or Structurally Connected	488,987	10.83%	$240,191,037,384	$491,201	13.49%
Nails, Toe Nails, Screws, Gravity, Friction, Adhesive Epoxy, Other, or Unknown	4,025,448	89.17%	$1,539,852,526,027	$382,529	86.51%
TOTAL	4,514,435	100.00%	$1,780,043,563,411	$873,731	100.00%
ROOF-DECK ATTACHMENT					
Reinforced Concrete Roof Deck	6,975	0.15%	$4,803,422,173	$688,663	0.27%
Other or Unknown	4,507,460	99.85%	$1,775,240,141,238	$393,845	99.73%
TOTAL	4,514,435	100.00%	$1,780,043,563,411	$1,082,508	100.00%

Table 30: 2007 Reported Exposures as of 2/11/08: Source - "FHCF 2008 Ratemaking Formula Report to the SBA of Florida, Revised May 2008"

2008 Ratemaking Formula Report

2007 Reported Exposures as of 2/11/08

Residential Totals By Mitigation Features

Mitigation Feature	Units	Percent of Units	Primary Exposure	Average Exposure	Percent of Exposure
YEAR BUILT	164,946	3.63%	$32,440,166,293	$196,671	1.91%
Unknown or Mobile Home	2,969,016	65.39%	$982,045,417,853	$330,765	57.88%
1994 or Earlier	659,032	14.51%	$312,264,243,394	$473,823	18.40%
1995-2001	747,375	16.46%	$370,003,301,618	$495,070	21.81%
2002 or Later	4,540,369	100.00%	$1,696,753,129,158	$1,496,329	100.00%
TOTAL	164,946	3.63%	$32,440,166,293	$196,671	1.91%
FLORIDA BUILDING CODE INDICATOR					
Meets 2002 FL Building Code	649,408	14.30%	$317,658,455,680	$489,151	18.72%
Does Not Meet FL Building Code or is Unknown	3,890,961	85.70%	$1,379,094,673,478	$354,435	81.28%
TOTAL	4,540,369	100.00%	$1,696,753,129,158	$843,586	100.00%
STRUCTURE OPENING PROTECTION					
None or Unknown	4,092,081	90.13%	$1,453,438,018,393	$355,183	85.66%
Basic Shutters	93,405	2.06%	$40,530,082,140	$433,918	2.39%
Hurricane or Engineered Shutters or FBC-Equivalent	354,883	7.82%	$202,785,028,625	$571,414	11.95%
TOTAL	4,540,369	100.00%	$1,696,753,129,158	$1,360,515	100.00%
ROOF SHAPE					
Hip, Mansard, or Pyramid	685,175	15.09%	$349,401,720,621	$509,945	20.59%
Gable, Other, or Unknown	3,855,194	84.91%	$1,347,351,408,537	$349,490	79.41%
TOTAL	4,540,369	100.00%	$1,696,753,129,158	$859,435	100.00%
ROOF-WALL CONNECTION					
Anchor Bolts, Hurricane Ties, Clips, Single Wraps, Double Wraps or Structurally Connected	191,932	4.23%	$100,973,487,288	$526,090	5.95%
Nails, Toe Nails, Screws, Gravity, Friction, Adhesive Epoxy, Other, or Unknown	4,348,437	95.77%	$1,595,779,641,870	$366,978	94.05%
TOTAL	4,540,369	100.00%	$1,696,753,129,158	$893,068	100.00%
ROOF-DECK ATTACHMENT					
Reinforced Concrete Roof Deck	4,497	0.10%	$3,988,032,750	$886,821	0.24%
Other or Unknown	4,535,872	99.90%	$1,692,765,096,408	$373,195	99.76%
TOTAL	4,540,369	100.00%	$1,696,753,129,158	$1,260,016	100.00%

Citizens Summary of WMC information

Citizens Property Insurance Corporation
Windstorm Mitigation Credit Information
Data as of September, 2009 (*Excludes Take-Out Policies*)

Product Line	Policy Type	Number of Policies (1)	Number of Buildings (2)	Total Premium Excluding Wind Mitigation Credits and Surcharges (3)	Number of Policies with Wind Coverage (4)	Number of Buildings with Wind Coverage (5)	Total Wind Premium Excluding Surcharges (6)	Number of Policies with Wind Mitigation Credits (7)	Number of Buildings with Wind Mitigation Credits (8)	Total Wind Mitigation Credits (9)	Percent of Policies with Wind Coverage (10) = (4) / (1)	Percent of Wind Coverage Policies with Wind Mitigation Credits (11) = (7) / (4)	Average Wind Premium per Building with Wind Coverage (12) = (6) / (5)	Percent of Mitigation Credit to Wind Premium (13) = (9) / [(9) + (6)]	Average Wind Mitigation Credit (14) = (9) / (8)
PR-M	HO-3	281,462	281,462	$561,494,952	271,451	271,451	$547,516,169	165,774	165,774	$169,458,515	96%	61%	$2,017	24%	$1,022
	HO-4	11,092	11,092	$4,146,155	10,825	10,825	$4,069,557	5,614	5,614	$201,905	98%	52%	$376	5%	$36
	HO-6	66,413	66,413	$41,210,875	61,550	61,550	$38,938,569	30,933	30,933	$2,540,694	93%	50%	$633	6%	$82
	DP-1	29,280	29,280	$24,293,560	27,450	27,450	$23,503,979	7,871	7,871	$1,457,743	94%	29%	$856	6%	$185
	DP-3	182,470	182,470	$236,711,470	175,518	175,518	$230,828,090	69,300	69,300	$25,605,330	96%	39%	$1,315	10%	$369
	Total	**570,717**	**570,717**	**$867,857,012**	**546,794**	**546,794**	**$844,856,364**	**279,492**	**279,492**	**$199,264,187**	**96%**	**51%**	**$1,545**	**19%**	**$713**
PR-W	HO-3/HW-2	183,960	184,919	$321,651,437	183,960	184,919	$321,651,437	136,157	136,501	$243,627,203	100%	74%	$1,739	43%	$1,785
	HO-4/HW-4	12,897	13,167	$7,082,499	12,897	13,167	$7,082,499	9,278	9,495	$6,583,655	100%	72%	$538	48%	$693
	HO-6/HW-6	33,901	33,903	$22,161,768	33,901	33,903	$22,161,768	26,246	26,246	$18,594,377	100%	77%	$654	46%	$708
	DW-2	22,015	22,015	$26,091,256	22,015	22,015	$26,091,256	14,427	14,427	$17,405,806	100%	66%	$1,185	40%	$1,206
	Total	**252,773**	**254,004**	**$376,986,960**	**252,773**	**254,004**	**$376,986,960**	**186,108**	**186,669**	**$286,211,041**	**100%**	**74%**	**$1,484**	**43%**	**$1,533**
CR-M	Apt Bldg	2,219	8,298	$36,487,296	2,159	8,163	$36,250,189	1,101	4,997	$11,481,587	97%	51%	$4,441	24%	$2,298
	Condo Assn	5,831	38,705	$245,115,170	5,663	38,177	$243,957,203	4,875	32,688	$104,068,657	97%	86%	$6,390	30%	$3,184
	Home Assn	965	8,036	$19,450,172	955	7,992	$19,295,200	437	6,602	$12,908,564	99%	46%	$2,414	40%	$1,955
	Total	**9,015**	**55,039**	**$301,052,638**	**8,777**	**54,332**	**$299,502,592**	**6,413**	**44,287**	**$128,458,808**	**97%**	**73%**	**$5,512**	**30%**	**$2,901**
CR-W	Apt Bldg	5,348	8,376	$19,530,837	5,348	8,376	$19,530,837	1,866	3,390	$8,493,533	100%	35%	$2,332	30%	$2,505
	Condo Assn	6,618	23,819	$175,790,357	6,618	23,819	$175,790,357	5,388	20,288	$139,263,216	100%	81%	$7,380	44%	$6,864
	Home Assn	429	2,635	$4,592,750	429	2,635	$4,592,750	318	2,103	$10,425,717	100%	74%	$1,743	69%	$4,958
	All Other CR	1,452	5,031	$15,753,506	1,452	5,031	$15,753,506	481	1,370	$9,820,025	100%	33%	$3,131	38%	$7,168
	Total	13,847	39,861	$215,667,450	13,847	39,861	$215,667,450	8,053	27,151	$168,002,491	100%	58%	$5,410	44%	$6,188
Personal Residential		**823,490**	**824,721**	**$1,244,843,972**	**799,567**	**800,798**	**$1,221,843,324**	**465,600**	**466,161**	**$485,475,228**	**97%**	**58%**	**$1,526**	**28%**	**$1,041**
Commercial Residential		**22,862**	**94,900**	**$516,720,088**	**22,624**	**94,193**	**$515,170,042**	**14,466**	**71,438**	**$296,461,299**	**99%**	**64%**	**$5,469**	**37%**	**$4,150**
Total Residential		**846,352**	**919,621**	**$1,761,564,060**	**822,191**	**894,991**	**$1,737,013,366**	**480,066**	**537,599**	**$781,936,527**	**97%**	**58%**	**$1,941**	**31%**	**$1,454**

Acronym	Product or Description
PR-M	Personal Residential Multi-Peril
PR-W	Personal Residential Wind-Only
CR-M	Commercial Residential Multi-Peril
CR-W	Commercial Residential Wind-Only
HO-3 or HW-2	Homeowner
HO-4 or HW-4	Tenant
HO-6 or HW-6	Condominium Owner
DP-1	Dwelling Fire - Basic Form (Limited Coverage
DP-3 or DW-2	Dwelling Fire - Special Form

Source: FCHLPM_WMCStudy_093009_012510_detail.pdf

APPENDIX C: METHODOLOGY

Incorrect Application of Credits

One of the questions related to the use of WMCs is how they should be applied to the premium. When applied incorrectly the premium credit can be overstated or understated. Overstatement would add to the decrease in insurers' premium revenue, while understatements would be lessening the decrease in premiums that policyholders should receive according to the current regulations. To quantify this type of overstatement, RMS has calculated the premium for several fidelity levels where the WMC is applied incorrectly and compared it to the correctly calculated premiums. The correct premium calculation has the WMC applied to the wind portion of the premium, excluding the fixed expenses, while the incorrect premium calculation has the WMC applied to the premium that includes fixed expenses.

The table below shows the approximate overstatement of the WMC for fidelity levels of 10%, 40%, and 80% for a typical policy in each county. The results show that when the WMC is relatively small, the overstatement is also quite small, approximately 1%. However, as the WMC gets larger, the overstatement can become quite significant, up to 12% in some counties. This overstatement is more significant in lower risk counties, as shown in the map below. It is important to keep in mind that these calculations are for the identical specified policy in each county and do not reflect geographic distribution.

Table 31: Approx. Overstatement of WMC for Typical Policy in each county at different WMC levels

County Code	Region1	Region2	County	WMC = 10%	WMC = 40%	WMC = 80%
29	C	C	DIXIE	1.0%	4.1%	8.1%
35	C	C	FLAGLER	0.7%	3.0%	5.9%
17	C	C	CITRUS	0.7%	2.8%	5.7%
127	C	C	VOLUSIA	0.5%	2.2%	4.3%
75	C	C	LEVY	0.5%	2.1%	4.3%
109	C	C	SANTAROSA	0.5%	2.1%	4.1%
53	C	C	HERNANDO	0.5%	1.9%	3.7%
9	C	C	BREVARD	0.4%	1.6%	3.2%
103	C	C	PINELLAS	0.4%	1.5%	2.9%
101	C	C	PASCO	0.3%	1.4%	2.8%
57	C	C	HILLSBOROUGH	0.3%	1.2%	2.5%
111	C	C	SARASOTA	0.3%	1.2%	2.4%
81	C	C	MANATEE	0.2%	0.6%	1.3%
61	C	C	INDIANRIVER	0.1%	0.5%	1.0%
83	C	I	MARION	1.2%	4.8%	9.5%
27	C	I	DESOTO	0.9%	3.8%	7.5%
107	C	I	PUTNAM	0.9%	3.5%	7.1%
117	C	I	STLUCIE	0.9%	3.5%	7.0%
55	C	I	HIGHLANDS	0.8%	3.2%	6.5%
93	C	I	OKEECHOBEE	0.8%	3.2%	6.4%
41	C	I	GILCHRIST	0.8%	3.1%	6.1%
1	C	I	ALACHUA	0.6%	2.5%	5.0%
69	C	I	LAKE	0.6%	2.2%	4.4%
119	C	I	SUMTER	0.5%	2.2%	4.4%
49	C	I	HARDEE	0.5%	2.2%	4.4%
97	C	I	OSCEOLA	0.5%	2.0%	4.0%
95	C	I	ORANGE	0.4%	1.7%	3.5%
105	C	I	POLK	0.4%	1.5%	2.9%
123	N	C	TAYLOR	1.0%	3.9%	7.8%

County Code	Region1	Region2	County	WMC = 10%	WMC = 40%	WMC = 80%
31	N	C	DUVAL	0.8%	3.3%	6.7%
89	N	C	NASSAU	0.5%	2.2%	4.3%
45	N	C	GULF	0.5%	2.1%	4.2%
65	N	C	JEFFERSON	0.5%	2.0%	3.9%
129	N	C	WAKULLA	0.5%	1.9%	3.8%
5	N	C	BAY	0.4%	1.5%	3.1%
91	N	C	OKALOOSA	0.3%	1.3%	2.7%
131	N	C	WALTON	0.3%	1.2%	2.4%
37	N	C	FRANKLIN	0.3%	1.2%	2.4%
33	N	C	ESCAMBIA	0.3%	1.1%	2.3%
113	N	C	SEMINOLE	0.2%	0.7%	1.5%
63	N	I	JACKSON	1.6%	6.3%	12.6%
47	N	I	HAMILTON	1.6%	6.2%	12.4%
39	N	I	GADSDEN	1.2%	4.9%	9.8%
73	N	I	LEON	1.2%	4.8%	9.6%
19	N	I	CLAY	1.2%	4.8%	9.5%
77	N	I	LIBERTY	1.1%	4.5%	9.0%
59	N	I	HOLMES	1.0%	4.1%	8.2%
67	N	I	LAFAYETTE	0.9%	3.8%	7.5%
7	N	I	BRADFORD	0.9%	3.5%	7.0%
125	N	I	UNION	0.8%	3.1%	6.3%
13	N	I	CALHOUN	0.7%	3.0%	6.0%
79	N	I	MADISON	0.7%	2.9%	5.8%
23	N	I	COLUMBIA	0.7%	2.8%	5.7%
3	N	I	BAKER	0.7%	2.7%	5.4%
133	N	I	WASHINGTON	0.7%	2.7%	5.4%
121	N	I	SUWANNEE	0.7%	2.6%	5.2%
15	S	C	CHARLOTTE	0.3%	1.3%	2.7%
115	S	C	STJOHNS	0.3%	1.1%	2.2%
86	S	C	MIAMIDADE	0.2%	0.9%	1.7%
71	S	C	LEE	0.2%	0.8%	1.6%
11	S	C	BROWARD	0.2%	0.8%	1.6%
21	S	C	COLLIER	0.2%	0.7%	1.5%
99	S	C	PALMBEACH	0.2%	0.7%	1.3%
87	S	C	MONROE	0.1%	0.5%	1.0%
85	S	C	MARTIN	0.1%	0.4%	0.8%
51	S	I	HENDRY	0.7%	2.7%	5.3%
43	S	I	GLADES	0.4%	1.7%	3.5%

Region 1: N = north, C = Central, S = South

Region 2: C = Coastal, I = Inland

Realignment Premium Level Calculations

A loss ratio calculation was used to determine the estimated premium need. The formula is that contained in the RIF. The section of the form used is copied below. Premium in force was used as the denominator and all losses were assumed to be fully developed and trended. 100% credibility was given to the indication. For the non-wind losses, the loss ratio was set to be that derived from the rated premium allocation described in Section 4. The initial hurricane expected losses (for the 0% fidelity case) were from the AAL and LAE associated with the wind percentage of rated premium. This was deliberately done so that the initial calculation showed an adjustment of 0% for use as a starting point.

Adjustments to wind expected losses were made in the same proportion as the decrease in expected hurricane average annual losses seen in modeled AALs when the “old unknown” vulnerability functions are inappropriately invoked.

STATE OF FLORIDA – OFFICE OF INSURANCE REGULATION
HO/MHO/DF STANDARDIZED RATE INDICATIONS WORKBOOK

STATE EXHIBIT 1
SHEET 1

RATE INDICATIONS

PROSPECTIVE EXPENSE PROVISIONS (% OF PREMIUM)			
Category of Expected Expense	[47] Fixed Expense Loading	[48] Variable Expense Loading	[49] Total Expense Loading
Commissions	0.0%	17.0%	17.0%
Other Acquisition	1.5%	2.5%	4.0%
General	2.5%	2.5%	5.0%
Premium Taxes	0.0%	1.8%	1.8%
Misc. Licenses & Fees	0.0%	0.0%	0.0%
Profit & Contingency	0.0%	3.7%	3.7%
Contingent Commissions	0.0%	0.0%	0.0%
Non-FHCF Reins. Cost	25.0%	0.0%	25.0%
FHCF Reins. Cost	0.0%	0.0%	0.0%
Other Expense	0.0%	0.0%	0.0%
TOTAL EXPENSES	29.0%	27.5%	56.5%
PERMISSIBLE LOSS & LAE			43.5%

DEVELOPMENT OF RATE LEVEL INDICATIONS		
[50]	Expected Wind Loss & LAE ratio	Projected Hurricane Loss & LAE ratio
[51]	[50] + nonwind loss ratio	Proj. Incurred Loss & LAE Ratio (Incl. all catastrophes)
[52]	TOTAL EXPENSES [47]	Expected Fixed Expense Ratio
[53]	TOTAL EXPENSES [48]	Expected Variable Expense Ratio
[54]	{([51] + [52]) / (1-[53])}-1	Rate Level Indication

Figure 32: OIR I-File Rate Indication

APPENDIX D: SURVEY ABOUT THE USE OF MITIGATION CREDITS IN THE REINSURANCE MARKET

The following write up summaries the results and observations collected during our survey process. This section also contains a copy of the survey form that was used to frame the interviews and discussions held with the reinsurance brokers and reinsurance underwriters in our survey:

Survey results

RMS conducted a series of short 1.5 hour surveys with some key contacts in the reinsurance industry that could provide more color around how primary-reinsurance mechanism currently deals with mitigation information, and what could be improved. RMS surveyed leading reinsurance brokers and reinsurers with significant market share in Florida property catastrophe reinsurance, with the objective of gathering qualitative information on the reinsurance market's views and handling of mitigation credits in their analysis of Florida property insurance exposure AND this market's handling of credits in pricing reinsurance capacity in Florida. The survey focused on the following key topics:

- Data Completeness
- Data Quality
- Use of Data in Modeling
- Reinsurance Pricing
- Mitigation Credits

Following is a summary of survey responses:

Data Completeness:

Reinsurance brokers and reinsurers all confirmed that insurers operating in the Florida property insurance market are doing a good job of capturing data on mitigation factors. It is believed that all insurers are capturing at least some of this information – in fact, some insurers have even rewritten their policy application processes in order to embed these data fields into the application process so that the data will be captured. It was noted that the Florida domestic insurers are much more focused on the mitigation credit (data) issue than regional or national companies because it impacts the Florida domestics more.

The reinsurance market is aware of the concerns about errors and possible fraud in the windstorm mitigation credit program in Florida and want primary insurers to explain their [overall] data collection processes – from data collection from the application, validation of data with third-party sources, quality assurance reviews such as underwriting inspections and re-inspections of homes receiving mitigation credits.

We could not definitively determine if insurers that provide "better and more complete" data receive better pricing, capacity or contract terms from reinsurers; however, it was noted that reinsurers are looking to provide reinsurance capacity to primary insurers with a more solid understanding of the risks they insure.

Data Quality:

As with Data Completeness, the primary insurer's data collection processes are important to reinsurer acceptance of the quality of mitigation factor data being submitted. Reinsurers have been supporting Florida property catastrophe insurance for several decades, so they have been able to see a specific insurer's data detail grow and improve over time.

There is concern among reinsurers about the credibility of the data being submitted showing secondary modifier information related to mitigation credits. It was mentioned that some primary insurers look at modeled results with and without secondary modifier information because they do not have confidence in the data submitted by insureds on the "1802" forms; concerns reinforced by recent re-inspection programs where error rates (resulting in incorrect application of mitigation credits on the policy) have been as high as 60-70%.

Use of Data in Modeling:

It was noted that both insurers and reinsurers believe the catastrophe models give too much impact to secondary modifiers.

Insurers and reinsurance brokers do use third-party data sources (as well as individual property inspections and re-inspections) in order to validate mitigation credit data and other underwriting information.

Reinsurers will review modeled portfolio results with the secondary modifier information provided in a primary insurers portfolio against the modeled output without the secondary modifier information provided. It was not disclosed what, if any, impact this may have on reinsurance pricing on a particular portfolio.

In summary, insurers and reinsurers are incorporating secondary modifier information into modeling their portfolios; however, there is concern about the data, and a greater concern that the models are giving "too much" credit for mitigation factors.

Reinsurance Pricing:

Reinsurance pricing and the capacity to be provided is only slightly impacted by mitigation credits. It was noted that there are so many other technical (e.g., cat model and financial model analyses) and non-technical (e.g., company historical results, strength of management team, catastrophe response plan and capabilities, etc.) factors that impact reinsurance pricing and capacity that mitigation credits may provide an insurer a small price adjustment, but it was generally felt this is inconsequential and impossible to quantify.

It was also felt that Florida does not generate enough premium in the property insurance sector for the exposure, so reducing the premium levels available to primary insurers by the application of mitigation credits is reducing the revenue side without a similar reduction in expected losses. With the reinsurers not including the "same" mitigation credits as the primary insurers are required to provide, the relative cost of reinsurance (i.e., reinsurance cost as a percentage of overall premium) has increased.

Mitigation Credits:

Insurers and reinsurers have concerns about the validity of applying credits to a home for the application of individual mitigation techniques versus "hardening the entire shell" of the home. For example, applying a [significant] credit to the policy premium for an insured to purchase windstorm shutters does not necessarily reduce the likelihood of a significant loss to that property if other critical factors are substandard, such as the age of the roof (e.g., condition of the roof itself, is there a secondary water barrier, deck attachment, etc), garage door opening, etc.

Survey Form:

Background:

Recently, the OIR reported in a November 10, 2009 press release that 102 of 215 insurance companies in Florida reported underwriting losses in the second quarter of 2009[21] *without* the occurrence of a hurricane. This situation is of great concern to the insurance companies, the regulatory agencies, and the citizens of the state. Many insurance companies are pointing to the magnitude of what are called "windstorm mitigation credits" as being at least partially responsible for the current situation. In reaction, many companies are implementing windstorm mitigation credit re-inspection programs to verify the validity of granted mitigation credits.

Last legislative session, the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) was directed in F.S. Sections 627.0628 (4) to hold public meetings regarding the development, application and implementation of these "windstorm mitigation credits ." The FCHLPM's Windstorm Mitigation Committee was formed, and has held a series of public hearings and working sessions since the fall of 2009. The FCHLPM will be preparing a report for delivery on February 1, 2010 which will summarize the public testimony and opinions and recommendations of the commission members who are examining this issue. RMS has attended, provided testimony and actively participated in these hearings, and will continue to provide its input as appropriate as the commission wraps up its work.

Testimony in these hearings has come from many parties including the Office of Insurance Regulation, catastrophe modeling firms, inspection firms, insurance agents, insurance companies, trade groups, citizen action groups, and practicing actuaries. During the hearings, testimony has been given on topics such as:

- The background behind the ARA reports that are used as the basis for the currently recommended mitigation credits.
- The process used by the Florida Office of Insurance Regulation (OIR) to implement the loss relativities from the ARA reports and the relationship with insurance companies' base rates.
- Timing issues that affect insurance companies with respect to the collection of the more detailed structural attributes through private inspectors and through the My Safe Florida Home program
- Data quality issues that various insurance companies are struggling with currently
- Barriers to reflecting the mitigation credits in the risk transfer between the primary insurance companies and reinsurance market.

The work of the FCHLPM's Windstorm Mitigation Committee is still in progress. The meeting on December 18, 2009 continued the process of refining the commission's recommendations which as of the last meeting are temporarily categorized as:

- Creation of an oversight entity for the mitigation credit system that would develop a unified and consistent vision for the State of Florida, placing an equal emphasis on hardening homes along with other objectives (i.e. financially stable insurers),
- Replacement of the current residential inspection system with an independent inspection organization
- Establishment of procedures that ensure collection and maintenance of complete, quality hurricane modeling data
- Amending the hurricane computer modeling structure to include a wind engineer
- Using windstorm mitigation discounts in a manner that reflects the best actuarial and scientific information

Note that some of the recommendations that are proposed by the FCHLPM are expected to address data quality issues in the inspection system. RMS assumes those issues are being studied by the Department under a different contract mechanism (DCS RFP 09/10-10) which is focusing on studying a statewide inspection system.

[21] Data supporting this statement is shown in http://www.sbafla.com/methodology/pdf/2009/wmc/PropertyUnderwritingGain09142009.pdf

This project has been structured to present a comprehensive summary and analysis of the use of windstorm mitigation credits in the state of Florida, and how the impact of these credits has affected insurance companies and insurance premiums in the state. Essentially this project will begin to address the FCHLPM's last recommendation category – best and most efficient use of windstorm mitigation credits.

For this project, RMS believes that the state is best served not by simply summarizing the information presented to the FCHLPM – that will likely be done in the commission report itself - but by producing an series of quantitative analyses of the present situation through a series of illustrative scenarios that demonstrate the recent history of mitigation credit development, its impact on typical insurance companies, and a discussion of the how the recommendations proposed by the commission could change the current situation. These scenario analyses will draw on information presented at these FCHLPM hearings as well as RMS' analytic tools, databases, and expertise.

Our assessment of the current situation indicates that it is due to the confluence of several factors:

a. Implementation of relativity factors in insurance rating plans without consideration of underlying distributions of attributes.
b. Introduction of large amount of wind certification inspections in the market from the My Safe Florida program (2006-2008) has created a "timing" issue as insurers transition between from less detailed to more detailed data streams. RMS calls this a transition between low data fidelity to high data fidelity.
c. Voluntary data collection system creates data "fidelity" issues that act as barriers to effective risk transfer of mitigation signal from primary insurance market to reinsurance market.

The FCHLPM report will provide a broad description of the situation. In conjunction with that report, the RMS study will provide depth and focused detail in related to data and ratemaking. By providing an objective analysis of what is driving specific actions and reactions, we will provide a basis for the critical decisions of the future.

Purpose of Survey:

The survey is being developed to gather qualitative information on the current situation on the market, and what might be changed in the future.

- Information on the impact of mitigation measures on structures is available and is represented in data being examined by reinsurers. Yet they prefer to rely on the industry distribution defaults in the models rather than use the mitigation information collected by companies. Why is this? What would be the degree or type of information that would lead to use of the information?
- How have reinsurance costs changed over time for Florida personal property and how much of the change is due directly or indirectly to mitigation credits? Related to this is the issue of how any indirect causes work their way through the market.

Questions We Need You To Answer:

All the questions/answers below should be limited to Residential portfolios in the state of Florida only.

Topic	Question
Data Completeness	What fraction of clients are providing any secondary modifier information related to mitigation credits?
	In a "typical" portfolio, about what fraction of the locations have specific modifier information vs. unknown?
	Are there different levels of completeness for different types of companies – i.e. national carriers vs. Florida domestics?
	Do companies that present comprehensive data get treated differently than companies that present partial data sets? How is the treatment different? What are the factors in this treatment?
Data Quality	With respect to mitigation credits, what perceptions of data quality have been typical within the reinsurance community?
	Are there perceptions that reported information is erroneous?

Topic	Question					
	Is the partial data collection perceived as being biased?					
Use of Data in modeling	How do you deal with this information in the modeling process? For example, do you: a) leave the information in the modeling as is? b) Modify the information? Add in complementary information to account for potential biases c) remove secondary modifier information and assess losses based on primary attributes (relying on model's industry wide assumptions)					
	What are the barriers that prevent you from using mitigation credits (secondary modifier) information?					
Reinsurance Pricing	How has the price of reinsurance changed over the last 3 years? General trends are fine, but any approximate percent increase/decrease would be helpful as well.					
	Do you view mitigation credits differently between excess-of-loss ("XOL") and quota share reinsurance treaties? Why?					
	Do you view mitigation credits differently amongst different layers in an XOL structure – i.e., do you view mitigation credits as "only applying to" or lowering expected losses in lower level storms?					
	Has the introduction of mitigation credits been a factor at all in the pricing of residential reinsurance to date?					
	Anecdotally we have heard that reinsurers believe that Florida primary insurers' pricing is already so inadequate that reinsurers are already "discounting" their pricing in Florida, and therefore are unwilling or able to apply mitigation credits in the reinsurance pricing. Is this accurate; and if so, provide details.					
Mitigation Credits	Do you believe in the validity of applying individual mitigation credits to a property (e.g., a mitigation credit is applied because shutters are installed, but no other changes are made to the structure, such as the roof, garage door, etc.) versus hardening the entire "shell" of the home? Is it a factor of the amount of the credits provided for mitigation technique, or the overall concept that "partial mitigation" is hard to quantify?					
	What do you think needs to happen to have reinsurance pricing more fully reflect the mitigation signal? Rate the following from 1 to 5 (1 = not important; 5 = very important)					
	More published "proof" of the magnitude of loss reduction	1	2	3	4	5
	Partial data collection can potentially underestimate the reinsurance losses when data is reported only on mitigated homes. Mitigation features need to appear on at least X% of the locations in the portfolio	1	2	3	4	5
	What fraction of the portfolio do you think needs complete data capture before we eliminate the problem above.	__________%				
	Mitigation features need to appear on all locations	1	2	3	4	5
	Other	1	2	3	4	5

APPENDIX E: OVERVIEW OF RMS HURRICANE MODEL

The RMS® U.S. Hurricane model consists of four major model components, or modules:

- Stochastic Module
- Wind Field or Wind Hazard Module
- Vulnerability or Damage Assessment Module
- Financial Loss Module

Descriptions of each of the modules follow.

Stochastic Hurricane Module

The following steps describe the methodology used to generate stochastic storms at a location:

Step 1: Quantify the translational velocity characteristics of the historical storm set.

Stochastic (simulated) storms are derived from the analysis and parameterization of historical storm data. The historical storm database was developed with the participation of Charles J. Neumann, a meteorologist and one of the original researchers from the National Hurricane Center (NHC), who compiled the HURDAT Atlantic basin storm database [44]. The HURDAT database contains four pieces of information for each recorded tropical cyclone: time and date, latitude and longitude position, maximum sustained wind speed, and central pressure (when available). Working with Mr. Neumann, RMS engineers researched the background data on historical storms as well as specific information on several hurricanes. The RMS historical database was developed by incorporating the most reliable available information from this research. The investigation resulted in a more accurate definition of storm characteristics at landfall. Storms that reached Category 1 or above were used in the development of the model. RMS consulted with other experts, including Dr. Alan Davenport and Dr. Dale Perry, to collect more data and to seek their opinion on specific storms. The final RMS-developed database was again reviewed by Charles Neumann. Results of the NHC re-analysis project were also reviewed. The result of this exercise is a set of hurricanes that includes the same set of hurricanes specified by the Florida Hurricane Commission on Loss Prediction Methodology in the November 1, 2005 Report of Activities [25].

The model uses a random-walk technique by considering each hurricane to be advected by a 2D “turbulent” translational velocity field superimposed on a “mean” translational velocity field. Both mean and turbulent velocity fields are inhomogeneous in two dimensions so the translation equations have been formulated to incorporate the interaction of these in-homogeneities. Model inputs are computed from the tracks of historical events in the HURDAT catalog on a regular array of grid cells covering the whole Atlantic basin as shown in Figure 33. Historical tracks are classified into five types, depending on their point of formation and path. Each type is simulated separately.

- Type 1 storms (e.g., Floyd 1999) form in the Atlantic Ocean and curve up the East Coast of the U.S.
- Type 2 storms (e.g., Georges 1998) form in the Atlantic Ocean and do not curve up the East Coast of the U.S.
- Type 3 storms form off the East Coast of the U.S.
- Type 4 storms (e.g., Mitch 1998) form in the Caribbean Sea.
- Type 5 storms (e.g., Opal 1995) form in the Gulf of Mexico.

Figure 34 shows a sample of 150 simulated ”Type 2” hurricane tracks.

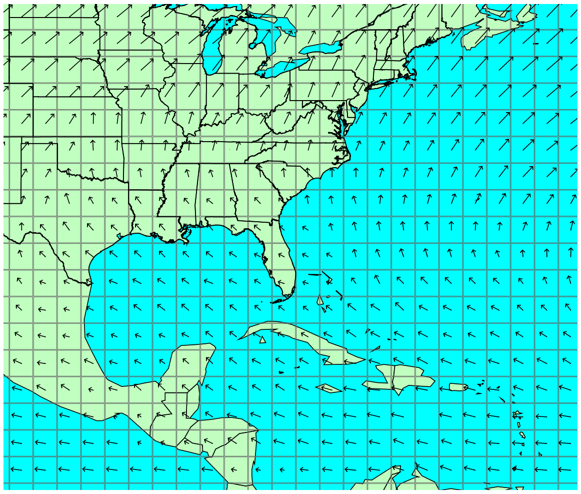

Figure 33: Mean Translational Velocities for “Type 2” Hurricanes on a 2º x 2º Grid

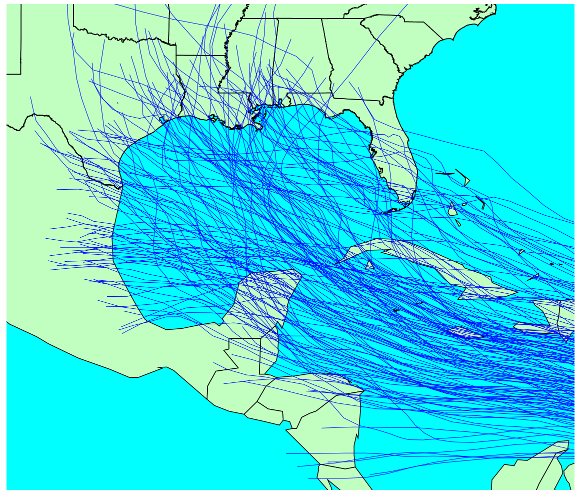

Figure 34: Sample of 150 Simulated “Type 2” Hurricane Tracks

Step 2: Simulate the storm tracks and calibrate against historical rates of occurrence.

Storm tracks are simulated using a random-walk technique. This method creates realistic synthetic events covering the entire Atlantic basin, which preserve the statistical behavior of the historical events (mean and variance of translational velocity). The random-walk technique is widely used in the areas of environmental fluid mechanics, particularly to simulate the dispersion of pollutants [53]. RMS is the first modeling company to apply this methodology to hurricane modeling [17]. Each event consists of a track (location, forward speed, and direction, central pressure and radius of maximum wind) defined throughout the life of the storm from its genesis to its dissipation.

Tracks are simulated in two steps. First, the tracks are created and second, pressure histories are added to the tracks using a random-walk technique for the pressure. The track model is calibrated across the Atlantic by comparing the rates of storms crossing a grid of cells covering the basin. A more detailed calibration is performed at the coastline by calculating the rate of crossing and probability density functions (pdf) of central pressure and forward speed on linear gates.

Step 3: Calculate target historical landfall rates and track parameter pdfs along the Florida coastline.

The U.S. coastline is first divided into segments about 50 nautical miles in length. This yields 22 coastal segments (segments 17 to 38) for the state of Florida as shown in Figure 35. There are also four coastal segments to represent the coastline of the neighboring states of Georgia, Alabama, and Mississippi. Historical crossings are determined for each coastal segment by smoothing across extensions to the segments. Probability density functions for central pressure are developed for each segment from landfall data supplemented by nearby, offshore track information. Pressure cumulative distribution functions (cdfs) are then smoothed by normalizing landfall rates by category to match the historical record at a regional level.

Probability density functions of forward speed are developed for groups of coastal segments. Lower and upper bounds are developed for all parameters based on regional hurricane characteristics to keep the parameters within a realistic range.

Step 4: Calibrate the storm tracks against landfall rates and forward speed pdfs at the coastline.

Calibration of landfall probabilities is performed on a series of segments, approximately 50 nautical miles in length that bound the entire U.S. coastline. The target historical probabilities are computed from the historical database using a smoothing algorithm that eliminates the spatial patchiness in the limited historical record. The stochastic model is then calibrated to match the historical rates of landfall.

Calibration of forward speeds is performed by computing pdfs of forward speed following the more traditional, general approach set forth in the National Weather Service publication NWS-38 [42]. Due to the limited length of the historical record, the calibration is performed at a regional level by grouping neighboring gates together.

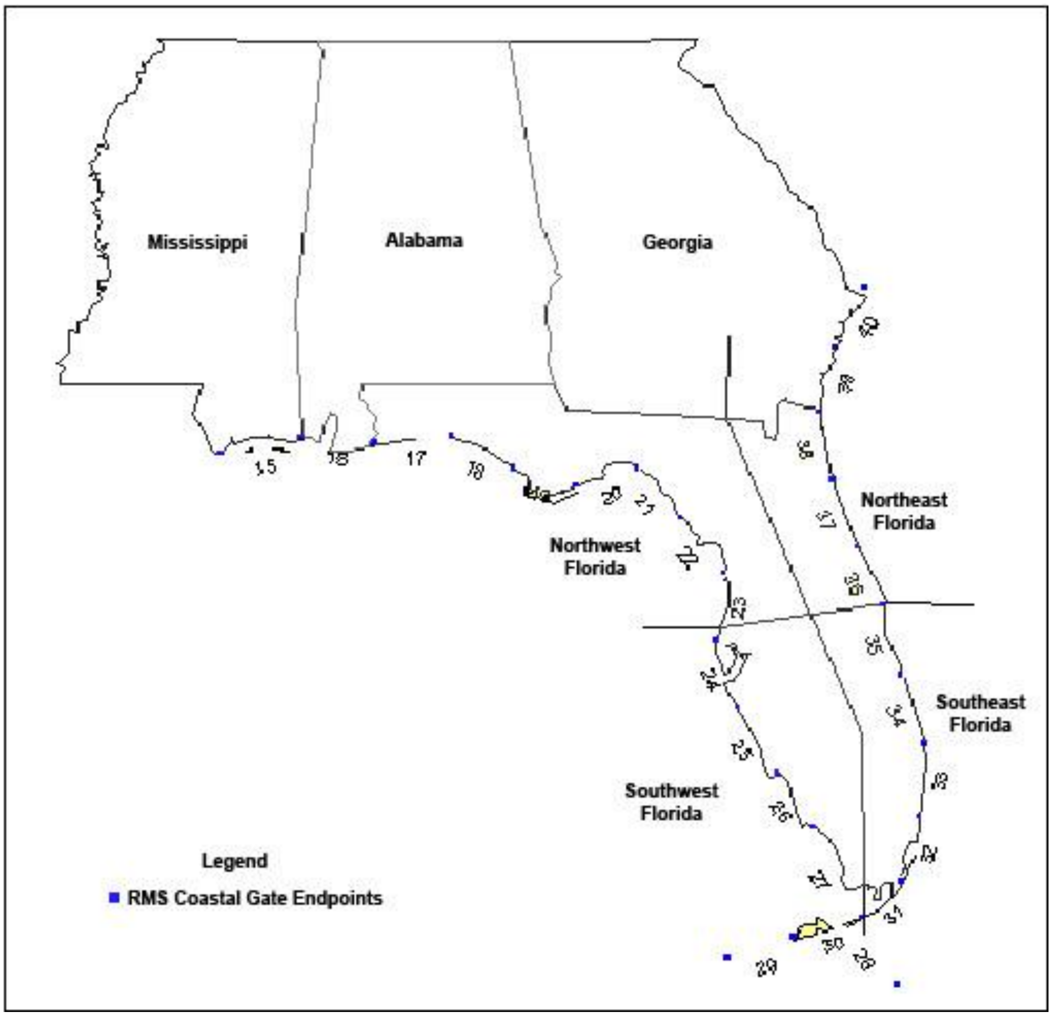

Figure 35: Coastal Segments Used for Parameter and Rate-Smoothing

Step 5: Add the pressure histories to each stochastic event taking into account changes in sea surface temperature (SST) and encounters with land along the way.

Pressure histories are added to the synthetic tracks using a second random-walk process. The rates of change of pressure along the synthetic tracks are defined through the mean and variance of pressure changes quantified from historical events. Storms tend to intensify faster over warm water than over cold water. Storms fill as they cross areas of land and may re-intensify if they move back out over the water. The filling rates for storms making landfall in Florida are modeled using the same functional form as the model of Kaplan and DeMaria [45]. Minimum pressures are constrained by theoretical arguments relating central pressure to SST. The pressure history of each storm thus depends on the track of the storm as it crosses areas of different SST and encounters topography.

Step 6: Calibrate the pressure histories against the pressure pdfs for each coastal gate.

The pressure history model is calibrated by specifying the pressure pdf on linear segments across the basin and around the coastline. The pressure history of each event is individually scaled so that the pressure pdf for each segment is obtained. In this way the random-walk model defines realistic pressure histories and the calibration ensures the correct intensities of simulated storms.

Step 7: Perform importance sampling of the Monte Carlo basin-wide storm set to produce the event set used for loss-cost determination.

Importance sampling of the simulated tracks is performed to create the computationally efficient event set used for loss cost determinations. For average annual loss calculations, the hurricane model contains 15,716 stochastic storms affecting US coast.

Wind Field or Wind Hazard Module

The Wind Field or Wind Hazard Module calculations determine the maximum localized wind speed associated with a storm event (historical or stochastic) over its life cycle. The wind speeds are calculated at a site identified by its latitude and longitude, taken either from a street-address-specific geocode or derived from the weighted centroid of a ZIP Code. The key storm parameters used in wind speed calculations include: central pressure, radius to maximum wind, wind profile, forward speed, direction, landfall location, and track.

The theoretical and analytical formulations of the wind field model are taken from a methodology originally developed at the Boundary Layer Wind Tunnel, University of Western Ontario, Canada [37] and [38]. The wind speed is calculated from the formula relating the site location relative to the storm track, the landfall location, and the physical parameters of the storm. The steps included in the wind field calculation are listed below.

Step 1: Estimate over-water gradient balance wind speed Vg.

The mean gradient wind speed, Vg, is calculated from the formula:

$$V_g = 0.5(V_T Sin(\alpha) - fR) + \left[0.25(V_T Sin(\alpha) - fR)^2 + \left(B \frac{\Delta P}{\rho} \right) \left(\frac{R_{\max}}{R} \right)^B e^{-\left(\frac{R_{\max}}{R} \right)^B} \right]^{\frac{1}{2}} \qquad (1)$$

where:

R = radial distance from the storm to the site

α = angle from storm track to site (clockwise is positive)

ΔP = central pressure difference

VT = storm translational speed

ρ = air density

f = Coriolis parameter (function of latitude)

B = pressure profile coefficient

Rmax = radius to maximum winds

Step 2: Estimate over-water wind field at 10 meter height V_s.

The 10-minute sustained over-water wind speed, Vs, is a function of the gradient wind speed and the relative position of the site to the storm track and is obtained from:

$$\frac{V_s}{V_g} = a + e^{\left(-b\frac{R}{R_{\max}} - c\left(\frac{R_{\max}}{2R}\right)\right)} \qquad (2)$$

where a, b, and c are constants that vary between left and right sides of hurricane track

Step 3: Estimate over land peak gust.

The model calculates over land peak gust wind speeds at a location by modeling both the effects of the local surface roughness and any change in the surface roughness conditions upwind of the location being considered. As the upstream roughness generally varies with direction about a particular location, the model considers the effects of upstream roughness by direction. The treatment of both surface roughness effects on mean and gust wind speed changes are modeled based on peer-reviewed wind engineering literature [10] and [115].

The starting point for the determination of land friction effects is the creation of a database that describes the surface roughness in terms of the roughness length. The definition of the roughness length arises from the use of a logarithmic velocity, or log-law, profile to describe the variation of the wind speed with height in the region immediately adjacent to the surface. Use of the log-law requires a measure of the underlying surface roughness, which is achieved through the use of the roughness length to parameterize the effect of surface roughness on the wind speed. The use of a roughness length also allows a physically based model to be used to calculate both local and upstream surface-roughness effects on the wind speed.

The database itself is created using the National Land Cover Data (NLCD) dataset produced by the USGS. This dataset is derived from early to mid-1990s Landsat Thematic Mapper satellite data and provides coverage of the entire continental U.S. at a horizontal resolution of 30 meters, using a 21-class land-cover classification scheme. This dataset has been supplemented by ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) satellite imagery to ensure the land use classification is timely with respect to current conditions in Florida. RMS then undertakes further processing of areas classified as urban or suburban in this database in order to differentiate areas of differing building heights. This is done primarily using data on the construction square footage by ZIP Code. At the same time, those land-cover classes whose effects on the surface wind speed are similar are merged into a single land-use class. The end result is a 10-class land-cover database with land-cover classes ranging from water to high-rise buildings. Finally, a representative roughness length is assigned to each of the 10 land-cover classes, using published mapping schemes from the scientific literature. The approaches used to develop roughness lengths have been independently reviewed by Dr. Nicholas Cook and Dr. Craig Miller.

Coefficients describing the impact of land friction are then calculated by using the roughness database in conjunction with GIS software to sample both the local and upstream-roughness conditions by direction at each point of interest. As the upstream roughness will generally vary with direction about a particular location, sampling of the upstream roughness must also be undertaken by direction. Information on the sampled roughness length values and their distance from the location are then used in conjunction with a physically based model to determine an appropriate set of coefficients describing the impact of land friction effects at the location by direction.

Vulnerability or Damage Assessment Module

Given an event, the model estimates the wind and surge (optional) hazards present at a user-specified site. Local wind and surge hazards are measured in terms of peak gust wind speed and flood depth, respectively. These parameters are then used to derive the estimate of damage to a specific location. Estimated damage is measured in terms of a Mean Damage Ratio (MDR) and a deviation around the mean represented by the Coefficient of Variation (CV). The MDR is defined as the ratio of the repair cost divided by replacement cost of the asset. The curve that relates the MDR to the peak gust wind speed is called a vulnerability function. RMS has developed vulnerability functions for over 500 building classifications. Each classification has a vulnerability function for damage to buildings due to wind and a vulnerability function for damage to building contents due to wind, as well as similar vulnerability functions for surge damage. The vulnerability classes depend on a combination of:

- Construction class
- Building height (number of stories)
- Building occupancy
- Year built
- Region

The vulnerability functions consist of a matrix of wind speed levels (measured as peak gust in mph) and corresponding MDRs. To calculate a MDR for a given location, RiskLink® first determines an expected wind speed, and then looks up the corresponding MDRs for building and contents based on the building classification. RMS has also developed CVs associated with each MDR. The CV is used to develop a probability distribution for the damage at each wind speed and for each classification. A beta distribution is used for this purpose.

The vulnerability relationships are developed using structural and wind engineering principles underlying the RMS Component Vulnerability Model (CVM) coupled with analysis of historical storm loss data, building codes, published studies, and RMS internal engineering developments in consultation with wind engineering experts including the late Dr. Dale Perry and Dr. Norris Stubbs of Texas A&M University. The CVM allows objective modeling of the vulnerability functions, especially at higher wind speed ranges where little historical loss data is available. The CVM is also used to obtain the vulnerability relativities by building class and gain insight into the effects of hurricane mitigation. These approaches also build on the earlier input received from Dr. Peter Sparks of Clemson University, and Dr. Alan Davenport of the University of Western Ontario.

RMS also uses published documents, expert opinion, and conventional structural engineering analysis. RMS has reviewed research and data contained in numerous technical reports, special publications, and books related to wind engineering and damage to structures due to wind.

The RMS engineering staff includes several engineers with Ph.D. qualifications in Civil and Structural Engineering. These engineers have significant experience and expertise in the understanding of building performance and structural vulnerability, and are dedicated to the development of vulnerability relationships for risk models worldwide. RMS engineers have participated in several reconnaissance missions. The knowledge and data gathered during these site visits has been used in the calibration and validation of vulnerability functions. The final calibration of the vulnerability functions has been made using over $9 billion of loss data, with corresponding exposure information.

The vulnerability of buildings modeled by each of the building classes represents the "average" vulnerability of a portfolio of buildings in that class. The vulnerability will vary depending upon specific characteristics of buildings in that portfolio. This variation can be addressed in the model through the use of secondary modifiers that can consider secondary building characteristics or mitigation measures to improve a building's wind resistance. The secondary modifiers could be building-characteristic specific (e.g., improved roof sheathing or anchors) or external (e.g., storm shutters). These secondary modifiers modify the base, “average” vulnerability functions according to specific building characteristics or mitigation measures.

The following table describes how RMS’ secondary modifiers can be used to reflect the impact of mitigation measures required by Florida Statute 627.0629 (1).

Table 32: Recommended Secondary Modifiers for use with Buildings Built Before March 2002

Florida Statute 627.0629 (1) Mitigation Technique	**Recommended RMS Secondary Modifier**		
	Modifier Option Number	RMS Modifier	RMS Modifier Option
OPENING PROTECTION CRITERIA			
Hurricane - Windows or All	19-1	Wind Resistance - Windows	Engineered Shutter
Basic - Windows or All	19-6		Well designed plywood shutter
Ordinary Non-Impact	19-9		Shutter designed for pressure only
No Opening Protection	19-5		No shutter
Shutters Class A	19-1		Engineered Shutter
Shutters Class B	19-2		Simple Plywood Shutter
No Shutters	19-5		No shutter
ROOF DECK CRITERIA			
6d @ 6"/12"	14-5	Roof Sheathing Attachment	6d Nails MNS
8d @ 6"/12"	14-8		8d Nails MNS
8d @ 6"/6"	14-9		8d Nails HNS
Dimensional Lumber Deck	14-10		10d nails or screws
Reinforced Concrete Roof Deck	4-1	Roof System Covering	Concrete Fill*
ROOF SHAPE (ROOF TYPE) CRITERIA			
Hip	7-2	Roof Geometry	Hip
Mansard	7-4		Flat
Gable End with Bracing	7-8		Braced Gable unknown pitch
Gambrel	7-1		Gable high pitch
Gable End without Bracing	7-3		Gable unknown pitch
Complex	7-3		Gable unknown pitch
Flat	7-4		Flat
Unknown	7-0		Unknown
ROOF COVER CRITERIA			
Non-FBC Equivalent	4-5	Roof System Covering	Normal Shingle (55mph)
FBC Equivalent + No SWR	4-8		Rated Shingle (110 mph)
FBC Equivalent + SWR	4-9		Rated Shingle (110 mph) with SWR
Reinforced Concrete Roof Deck	4-1		Concrete Fill
ROOF ANCHOR CRITERIA			
Toe Nails	9-2	Roof Anchor	Toe nail
Clips	9-4		Metal anchor - Average Strength
Single Wraps	9-5		Metal anchor - Above Average Strength
Double Wraps	9-1		Metal anchor - High Strength
Unknown	9-0		Unknown

- *Note that this mitigation case is modeled using a separate secondary modifier
- SWR = Secondary Water Resistance

Financial Loss Module

To calculate losses, the damage ratio for each stochastic event derived in the Vulnerability Module is translated into dollar loss by multiplying the damage ratio by the value of the property. This is done for each coverage at each location. Using the mean and coefficient of variation, a beta distribution is fit to represent the loss distribution. From the loss distribution one can find the expected loss and the loss corresponding to a selected quantile. RiskLink® uses the loss distribution to estimate the portion of loss carried by each participant within a financial structure (insured, insurer, re-insurer). This distribution is used to calculate the loss net of any deductibles and limits.