FIRM

FAIR INSURANCE RATES IN MONROE

August 16, 2017

Mr. Barry Gilway, President
Citizens Property Insurance Corp.
301 West Bay St., Ste. 1300
Jacksonville, FL 32202

Dear Mr. Gilway:

Please find attached the results, conclusions, and background data and analyses of the Windstorm Risk Re-Modeling and Analysis Study conducted by Fair Insurance Rates in Monroe (FIRM). This study, graciously funded by Citizens Property Insurance Corporation (Citizens), was the most complex and detailed analysis of building strength and wind resistance ever attempted for a discrete geographic area (Monroe County) and, therefore, was of great interest to FIRM, Citizens, and the Florida Office of Insurance Regulation (OIR).

Windstorm insurance rates for Monroe County have historically been based on predicted losses using state accepted models applied at the state level. This study was an attempt to assess the predicted wind resistance of the building stock in Monroe County by actually examining a statistically valued sample of physical structures. A total of 699 structures across 32 defined categories (style, age, location, value) were inspected. This data was exceedingly difficult to obtain, as it required owners to permit trained inspectors to have access to the property. Additionally, where documentation verifying wind mitigation features was not available, the structures were not credited with having the feature. Nevertheless, the data, when entered into three state recognized and approved risk models (RMS, Florida Public, and AIR) showed significant loss reduction in all three models. However, the data did not show a reduction from Citizens recorded building characteristics.

It is important to note that FIRM learned that there are significant, unexplained (the models are proprietary and confidential) differences among all models utilized by Citizens when applied to Monroe County. Additionally, the models fail to recognize storm surge damage covered by flood insurance as in any way reducing wind insurance loss exposure. FIRM would like to see Citizens and OIR address the significant variations in model results, wind versus surge damage, and Monroe County's unique geography as an integral part of the rate setting process. For a detailed narrative and accompanying data, please refer to the attached document.

Sincerely,

Mel Montagne, President
Fair Insurance Rates in Monroe (FIRM)

cc: Commissioner David Altmaier
Sen. Anitere Flores
Rep. Holly Raschein
Lorilee Medders, PhD
CPIC Board of Governors

FIRM Monroe County Windstorm Risk Re-Modeling and Analysis Initiative Report

August 2017

Fair Insurance Rates in Monroe (FIRM)

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Key West, FL 33040

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Table of Contents

Executive Summary

This Report is the product of a 2013 agreement under which Citizens Property Insurance Company (Citizens) provided Fair Insurance Rates in Monroe (FIRM) with $485,000 to design and conduct a study to validate windstorm insurance rates in Monroe County, Florida (the Florida Keys). Citizens is a Florida governmental entity offering windstorm insurance to Monroe homeowners. FIRM is a non-profit advocacy group representing property owners in Monroe. With data more accurately reflecting Monroe's rigorous building codes and construction methods, as well as storm surge risk, FIRM sought both to demonstrate that Citizens rates are excessive and to attract other windstorm insurance providers to Monroe County.

FIRM engaged a risk-engineering consultant to capture characteristics of residential properties across Monroe County. Using a weighting system to ensure proportional representation, 700 homes were randomly selected from the 26,723 in the Monroe County Property Appraiser's database. The inspection process was designed to capture the unique construction type, size, elevation, roof height, roof shape, structural connections, shutters, roof condition, wind exposure, and flood zone characteristics of each home. Also captured were proximate risks from wave damage, wind speed and pressure, windstorm projectiles, and impacts from trees.

From April 2014 through March 2015 FIRM engaged a second firm to inspect 699 homes in 32 strata defined by building eras, geographical locations, and assessed building values, FIRM continuously reviewed results to ensure consistency and quality. Following a rigorous final review by FIRM and the consultant, the inspection data were input to three different hurricane catastrophe models (RMS, Florida Public, and AIR) approved by the Florida Commission on Hurricane Loss Projection Methodology (the Florida Commission).

Because of rigorous inspection standards used to qualify building characteristics and frequent lack of historical documents and building records, there were significant differences between building profiles in Study-derived and Citizens' own data. While inclusion of the inspected features in the models significantly reduced projected losses, those loss reductions were smaller than those projected using the Citizens' mitigation data.

However, the disparity among the models was astonishing. ***The projected average annual loss for Citizens' insured book of business by the AIR model was $51.9 million, more than two and a half times the $19.2 million loss projected by the RMS model,*** while the Florida Public model calculated the same loss at $27.2 million.

This disparity calls into question the accuracy and validity of the models used by Citizens. While the Florida Commission evaluates model accuracy with a statewide data set, Citizens rates are set at geographically discrete and unverified levels. Unfortunately, FIRM simply does not have the resources required to explain the disparity. While FIRM is still working to identify alternate windstorm solutions for Monroe County, FIRM calls upon the Florida Commission, the Florida Office of Insurance Regulation and Citizens to exercise their statutory responsibility to ensure a rate setting process that yields non-discriminatory, affordable and actuarially sound windstorm insurance rates.

Background

In April 2013 Heather Carruthers, then President of Fair Insurance Rates in Monroe County, Inc. (FIRM), and Sharon Binnun, then Chief Financial Officer of Citizens Property Insurance Company (Citizens), entered into an agreement (Attachment A) whereby Citizens would provide FIRM with $485,000 to design and conduct a study (the Study) of the Monroe residential housing stock. The goal of the Study was to determine the windstorm vulnerability of homes in Monroe County and thereby generate more accurate damage probability data that would drive rates and support the creation of alternate windstorm insurance arrangements for the County in furtherance of Citizens' depopulation efforts.

Study Work Effort

A detailed breakdown of this information is attached and all modeling results were shared with Citizens' staff as they became available, but in summary:

On September 16, 2013, Applied Research Associates, Inc. (ARA) entered into a contract with FIRM to perform certain services in support of the Study. Over time that contract underwent several revisions. The final version of the ARA FIRM agreement is included (Attachment B). The agreement outlines the risk engineering consulting services performed by ARA to deliver to FIRM:

- A list of sampled properties for inspection
- An inspection form
- A written final report with a summary and analysis of conclusions
- Spreadsheet of raw inspection data
- Spreadsheet comparing results to Citizens' data for Citizens-insured properties
- Three UPX input data files to be used as input files for the AIR-Worldwide (AIR) hurricane catastrophe model
- Five Florida Public Model input data files

Based on an analysis of existing data sets provided to ARA by FIRM, ARA developed a sampling plan employing standard stratified sampling techniques and considering the information and property characteristics available in the database to identify candidate properties for inspection.

A stratified random sample of homes was selected from the Monroe County Property Appraiser's (MCPA) total of 26,723 homes in the 2013 MCPA database designated as Property Class 0100 (residential). There were 32 strata defined by eight building eras (1800-1940; 1941-1961; 1962-1976; 1977-1983; 1984-1992; 1993-2002; 2003-2007; and 2008-2013); two categorical geographical locations (Key West and "not Key West"), and by quartile assessed building values (top quartile or within the lower three quartiles). Using a weighting system to ensure true proportional representation, a total sample size goal of 700 was calculated for a

statistical confidence as well as due to budget constraints. The Study ultimately yielded data for 699 homes spread proportionately across all 32 strata including geographical locations and assessed property value quartiles. Each home was assigned an ID number used to identify survey participants while maintaining confidentiality of data required by State statute.

ARA identified and defined the primary and secondary construction characteristics of residential properties such that they could be collected and mapped into the catastrophe models. Hurricane hazards considered included: wind speed and pressure, hurricane-generated missiles, rain and flooding, impacts from damaged and falling trees, and waves. Data collected also included: construction type, square footage, finished floor elevation, roof height, roof shape, visible structural connections (roof deck, roof-to-wall, and foundation), opening protection (e.g., shutters), roof covering type and age, wind exposure category, and flood zone.

ARA developed an inspection survey and procedure for use by trained engineering inspectors when conducting inspections.

Solaria Design and Consulting Co. (Solaria) was selected through a Request for Qualifications process to perform inspection and data collection services. There were three respondents to the RFQ and Solaria was deemed to be the most qualified for the task, and FIRM and Solaria entered into a contract (Attachment C). Solaria was originally assigned the task of scheduling as well as inspections while FIRM was to make "first contact" with homeowners. Scheduling the first 100 inspections necessitated approximately 4 to 5 attempts to contact prior to making an appointment for inspection, so it was agreed that FIRM administrative staff would perform subsequent scheduling for the remaining sample. Initial inspections started in April 2014 and all inspections were finalized by March 2015. Details of the efforts required to identify a sufficient number of homes for inspection are included as Attachment D.

Solaria insisted that engineering licensing standards mandate the use of elevated professional rigor for each inspection. No assumptions were made regarding any survey questions, and decisive evidence for survey determinations was required. This rigorous standard broadly impacted inspection results where detailed building plans, permits or product specification documents were not readily available.

Solaria performed 699 inspections and submitted the results to the FIRM Project Manager, Annalise Mannix, for quality control checks.

ARA reviewed the inspection results and developed statistical distributions, with confidence intervals, for the building characteristics used by catastrophe models.

ARA compared the results of the inspection program for Citizens-insured properties to the corresponding fields (where available) in the Citizens database. Comparisons were reported by building characteristic. A further analysis of these differences was conducted by Tonya Antoine

of Citizens in an EXCEL file on June 8, 2016. Both comparisons are available in EXCEL format upon request.

ARA additionally prepared and delivered input files for the AIR hurricane catastrophe model, the RMS hurricane catastrophe model and the Florida Public hurricane catastrophe model.

ARA was finally tasked with preparing a written report which included a summary of the conclusions, sampling procedure, inspection procedure, data collected, analysis of the data, and references (Attachment E).

Final Study data used for risk analysis modeling included:

- A portfolio containing 18,182 properties residing in Monroe County, Florida, covered by Citizens with a total value of $6,696,027,985 as of December 31, 2015, used for what at that time was Citizens' most recent rate filing.
- A 699-location portfolio with a total value of $317,930,596. These were of all of the homes that were inspected during the Study and that were passed through the quality assurance process.
- A 486-location subset of the Monroe County portfolio, with a total value of $224,452,508. These were the homes inspected in the Study that were insured by Citizens.

Ultimately several scenarios were run through:

- the AIR model by Citizens
- the RMS model by RMS (RMS contract Attachment F)
- the Florida Public Model by Florida International University

Those scenarios were designed to calculate with each model:

- Loss levels for the entire portfolio with and without secondary modifiers found in the Citizens' database.
- Loss level for the 486-location subset of the Monroe County portfolio, with inspection-derived secondary modifiers.
- Loss level for the 486-location subset of the Monroe County portfolio, with Citizens' database secondary modifiers.

Study Results

While the results of the modeling reflected significant loss reduction through the inclusion of both the Citizens' and inspection-derived secondary modifier sets, those values were dwarfed by the differences in calculated loss outcomes generated by the different models. The rigorous inspection standards used to qualify building characteristics, along with the frequent lack of plans, documentation or accessible building department records led to significant differences between the Study-derived and Citizens' database building profiles. Results from both the AIR and RMS runs reflected loss levels with Citizens data that was 6.4% lower than loss data generated with inspection.

Average Annual Loss for 486 Monroe County Inspected Homes Insured by Citizens			
Model	No Secondary Modifiers	Citizens' Data	Inspection Data
RMS	$806,375	$571,898	$616,158
Florida Public	$1,246,926	$813,773	$904,379
AIR	not available	$1,550,104	$1,649,928

Average Annual Loss for All 18,182 Monroe County Homes Insured by Citizens	
Model	AAL
RMS	$19,184,838
Florida Public	$27,203,266
AIR	$51,931,988

One of the Study's goals was to identify the storm damage transferred from wind insurance to flood insurance as a result of storm surge. RMS was the only study model that dealt with this issue in detail and those modeling runs, as opposed to showing reductions, increased wind liability by 2% in the event of surge (Attachment G).

Conclusions

The Study results were surprising and disappointing to FIRM for a variety of reasons. Catastrophe analysis firms that had originally shown enthusiasm for the project eventually backed away from participation, and in the process wasted much of FIRM's time and effort. Identification of homes to be inspected became a significant hurdle. Homeowner outreach efforts and challenges are detailed in Attachment D. Delays in identification of homes led to delays in inspection and the loss of project management resources and focus. Documentation required to adequately profile the inspected homes proved very difficult to obtain and these challenges certainly impacted the Study results. Adequately identifying the interaction of storm surge damage and wind damage liability remains a work-in-progress for the catastrophe modelers, and the limited model results generated through the Study do not true with firsthand storm experiences in Monroe County.

There were additional project delays in identifying modeling resources and defining Citizens' data security requirements. FIU had originally been enthusiastic about running the Public Model as part of the Study, but that enthusiasm waned with the project delays. Ultimately, it was only through the intercession of OIR that the Public Model became available.

The broad loss variance among the three models inevitably leads to questions about model verification, validation and accuracy. The Florida Commission on Hurricane Loss Projection Methodology is presented with each model, and gauges model accuracy based on a state-wide data set. However, rates are charged based on outputs at more geographically discrete and unverified levels. Some models treat Monroe as part of the west coast region, some as part of the east coast, some bifurcate it. The Public Model treats it as its own region. As an example of model input differences that could significantly skew results, the expert involved in the approval of the Florida Public Model in 2015 stated the model assumes too many Category 3 hurricanes in Monroe County.

The effort and expertise required to arrive at meaningful answers to these validation and accuracy questions unfortunately far exceed FIRM's resources and capabilities. The Florida Commission on Hurricane Loss Projection Methodology, the Florida Office of Insurance Regulation and Citizens all, in part, share the responsibility to ensure a rate setting process that yields non-discriminatory, affordable and actuarially sound windstorm insurance rates for Monroe County.

FIRM is still working to identify alternate windstorm solutions for Monroe County, and what remains of the original $485,000 is earmarked for that task. A complete accounting of Study cost incurred to-date is included as Attachment H. FIRM thanks Citizens for funding the Study in the interest of reaching a better understanding of what both organizations agree is a wide divergence of scientific opinion when it comes to modeling predictions for Monroe County. The

RMS model, which is considered stable and well-respected by Citizens, last year indicated that a rate *decrease* was in order for Monroe County. FIRM will continue to work with Citizens and the OIR with discipline and analysis in order to reach an actuarially sound and fair methodology for determining the risk for Monroe County that guarantees affordable rates for its residents.

ATTACHMENT A

Citizens/FIRM
Rate Study Finding Agreement

Rate Study Funding Agreement

This Rate Study Funding Agreement ("Agreement") is entered into by and between Citizens Property Insurance Corporation, a Florida governmental entity ("Citizens") and Fair Insurance Rates in Monroe County, Inc., a Florida not for profit corporation ("FIRM").

IN CONSIDERATION of the mutual promises stated herein, the parties agree to the following:

1. Funding Commitment.
As part of its depopulation programs, Citizens agrees to transmit by wire funds in the amount of four hundred and eighty five thousand dollars ($485,000.00) to the order of FIRM once FIRM has procured the expert(s) with whom it will contract to design and conduct the study (the "Study") as described in the FIRM Monroe County Windstorm Risk Remodeling and Analysis Initiative proposal presented to Citizens Board of Governors on December 14, 2012, a copy of which is attached hereto as Exhibit A (the "Proposal"), and as is generally set forth in Paragraph 3 herein. Citizens is not responsible for payment of any amount above this funding commitment.

2. Study Activities.
FIRM agrees to conduct the Study using the methodology described in the Proposal. FIRM agrees to create and provide to Citizens a copy of the final report resulting from the Study.

3. Estimated Study Activities Budget.
The estimated cost of this project is $485,000. The breakdown is as follows:

(1) Vulnerability Study - Designed to verify the quality and characteristics of building stock in Monroe County: $230,000.

(2) Windstorm Risk Study - Designed to verify the reduced windstorm risk from storm surge on the Citizens book of business in Monroe County: $35,000.

(3) Natural Catastrophic Analysis - Designed to complete an independent analysis of the Citizens book of business and options for alternate insurance structures: $200,000.

(4) Overall Project Management: $20,000.

Except for the Overall Project Management fee which is capped at $20,000, nothing in this Paragraph (3) shall serve to prohibit reasonable adjustments to this estimated budget that the studies might necessitate during their course.

In addition, nothing in this Paragraph (3) shall serve to require Citizens to pay any additional funds above and beyond the $485,000 set forth in Paragraph (1) above.

4. Access to Data. Citizens shall provide all of the information FIRM and/or its retained experts request promptly and in the format requested (unless it is an unavailable format), with address level and/or geo-coded level without prejudice or the need to provide reasons for the request.

3. Use of Study Deliverables.
Citizens may copy, distribute and use without limitation the Study deliverables, which deliverables shall be considered public records.

4. Conflict of Interest Restrictions.
In all Study activities, FIRM and Citizens shall give due consideration for the prevention of conflicts of interest and the maintenance of expert independence in the design and conduct of the Study. Without limiting the foregoing, payments to Study experts must not be contingent on results and FIRM shall make no commitments for follow-on or related work.

5. Use of Funds.
FIRM shall use the funds only for those items described and in the amounts budgeted in the Proposal and set forth generally in Paragraph 3 above. All funds not used within a reasonable period after, and reasonably arising from any additional tasks associated with, completion of the Study shall be returned to Citizens. At the conclusion of the Study, FIRM shall provide a final accounting of the use of the funds with copies of receipts. FIRM shall only use the funds for reasonable expenses of the Study and project management cost reimbursement not to exceed $20,000, and not for other FIRM operations or overhead.

6. Return of Funds.
Should the Study result in the creation of an entity or entities constituting a self-insurance fund or mechanism, FIRM shall take all steps reasonably necessary to facilitate each such entity treating the Natural Catastrophic Analysis study funds set forth in Paragraph 3(3) as a startup cost and each such entity repaying Citizens the cost, or prorated cost as the case may be, associated with that particular study.

7. General Terms.

Choice of Law. The parties agree that this Agreement and each party's performance shall be subject to and governed by Florida law.

Independence of the Study. The Study is a project initiated and controlled by FIRM independent of Citizens. Citizens does not in any way control the outcome of the Study. Both FIRM and Citizens agree to refrain from attempts to influence the outcome of the Study.

Conflict of Terms. If there are any conflicts between the terms of this Agreement and the Proposal, the terms of this Agreement shall control.

Data Confidentiality. FIRM understands that Citizens must treat policyholder data as confidential pursuant to Section 627.351(6)(x), Florida Statutes. Citizens will only disclose such data to a person or entity as permitted by such Statute and only under a confidentiality agreement.

Acknowledged and agreed between the parties through their undersigned authorized representatives this ___ day of April, 2013:

Fair Insurance Rates in Monroe County, Inc.

Name: Heather Carruthers

Title: President

Citizens Property Insurance Corporation

Name: Sharon Binnun

Title: CFO

Citizens Property Insurance Corporation

Name: Kelly Booten

Title: VP EPPM

ATTACHMENT B

ARA Risk Consulting Services Contract

September 16, 2013

Modification #1: November 16, 2015

Modification #2: July 2, 2016

Scope of Work

Risk Engineering Consulting Services

Prepared for:

Fair Insurance Rates in Monroe (FIRM)
422 Fleming Street
Key West, FL 33040

FIRM Point of Contact:
Steve Russ
Phone: (305) 294-0968
Email: steve.russ1@att.net

Prepared by:

Applied Research Associates, Inc. (ARA)
8537 Six Forks Road
Suite 600
Raleigh, NC 27615

ARA Points of Contact:

Francis M. Lavelle, Ph.D., P.E.
Phone: 919-582-3350
Email: flavelle@ara.com

Lawrence A. Twisdale, Jr., Ph.D., P.E.
Phone: 919-582-3336
Email: ltwisdale@ara.com

Introduction

FIRM desires to accurately determine windstorm vulnerability using the best science, accounting for all risks associated with hurricanes, and identifying actual building characteristics in the Keys. The purpose of this contract is to provide the risk engineering consulting services specified below in support of this goal.

Statement of Work

ARA will perform the following tasks:

Task 1: Project Kickoff Meeting. Attend a one day meeting with the FIRM project team to discuss the project plans and procedures, data needs, and review/tune objectives and deliverables. Review list of all residential properties in Monroe County, and determine which are to be in the study. The resulting list will form the population of the properties which will be used to develop statistical sampling plan and to identify the properties randomly selected for inspection.

Review the database of all relevant insured properties by CPIC. Relevant building data to be collected in inspection will be discussed in this meeting. The overview of sampling plan approach will be discussed and acceptable sampling tolerance and confidence level will be discussed and set based on available inspection resources.

Task 2: Development of Sampling Plan. This task includes analysis of existing data sets provided to ARA by FIRM (see list of items below under "Data" heading on page 5) and development of a sampling plan using the sampling tolerance and confidence level set in Task 1. Standard stratified sampling techniques are to be used, considering the information and property characteristics available in the databases of population of properties provided by FIRM, to identify candidate properties for inspection.

Prepare a draft survey plan for review. Upon receipt of comments, finalize survey design and draw samples. Provide samples in electronic format, including oversampling, to ensure adequate numbers in case of difficulties contacting homeowners during the scheduling phase.

Task 3: Development of Inspection Form. The primary and secondary characteristics of residential properties will be identified and defined such that they can be collected and mapped into the catastrophe models. Hurricane hazards considered will include: wind speed and pressure, hurricane generated missiles, rain and flooding, impacts from damaged and falling trees, and waves. Data collected will likely include: construction type, square footage, finished floor elevation, roof height, roof shape, visible structural connections (roof deck, roof-to-wall, and foundation), opening protection (e.g., shutters), roof covering type and age, potential for damage from falling trees, wind exposure category, and flood zone.

Task 4: Review of Inspection Results and Development of Characteristics of Population of Properties. This task includes review of the inspection results and development of statistical distributions, with confidence intervals, for the building characteristics used by catastrophe models. The probability distributions will be a function of the main sampling strata (e.g., year built era, building size/value, location with respect to flood zones, etc.) and will preserve correlations observed in the inspection data where statistically significant. The "Natural Catastrophe Risk Analysis Services" contractor will utilize the probability distributions to obtain improved estimates of Monroe County risk by replacing unknown

building characteristics in the CPIC exposure data with characteristics sampled from the probability distributions developed under this task.

Task 5: Review of Inspection Results for CPIC Insured Properties. The results of the inspection program for CPIC insured properties will be statistically compared to the corresponding fields (where available) in the 2015 CPIC database (to be provided to ARA by CPIC no later than November 30, 2015). Comparisons will be reported by building characteristic for each stratum used in the development of the sampling plan. The comparisons will be delivered separately from the final report in the form of an Excel spreadsheet and a memo summarizing the comparison results.

Task 6: Deleted.

Task 7: Final Report. This task consists of a written report which includes a summary of the conclusions, sampling procedure, inspection procedure, data collected, analysis of the data, and references.

Task 8: Preparation of Unicede/PX (UPX) Input Files. Under this task, ARA will prepare and deliver three Unicede/px (UPX) files (in version 16.0 format) that can be used as input files for the AIR hurricane catastrophe model. There will be one location record and one location detail in each file for each of the approximately 700 inspected houses. The location details (a.k.a. secondary modifiers) will be developed for the following three scenarios:

1. Unknown
2. As inspected
3. As characterized by Citizens for properties insured by Citizens and unknown for properties not insured by Citizens

ARA will be available to address any data formatting or data import issues for a period of 30 days following delivery of the UPX files.

Task 9: Preparation of input Files for Florida Public Model. Under this task, ARA will prepare and deliver five input files that can be used with version 6.1 of the Florida Public Model (FPM). The input files will cover the following five cases:

1. Entire Citizen Monroe County exposure with secondary modifiers based on Citizens data
2. Entire Citizen Monroe County exposure with unknown secondary modifiers
3. Locations insured by Citizens and inspected by FIRM (approximately 486 locations) with secondary modifiers based on Citizens data
4. Locations insured by Citizens and inspected by FIRM (approximately 486 locations) with unknown secondary modifiers
5. Locations insured by Citizens and inspected by FIRM (approximately 486 locations) with secondary modifiers based on FIRM inspection data

ARA will be available to address any data formatting or data import issues for a period of 30 days following delivery of the FPM input files.

Deliverables

The following work products will be delivered to FIRM by ARA:

1. A list of sampled properties for inspection.
2. An inspection form.
3. One meeting with FIRM in Key West (project kickoff)
4. A written final report consisting of a summary of the conclusions, sampling procedure, inspection procedure, data collected, analysis of the data, and references.
5. A consolidated spreadsheet of raw inspection data with one row for each inspected property and one column for each inspection data field.
6. Excel spreadsheet comparing inspection results to CPIC data for CPIC-insured properties
7. Three UPX input data files
8. Five Florida Public Model input data files

Project Management and Estimated Labor Hours

Dr. Frank Lavelle will manage this project for ARA and will be FIRM's main point of contact for the duration of the project. Dr. L. A. Twisdale will provide senior technical review of the project. Several other ARA engineers and scientists experienced in building survey design, building inspections, insurance data sets, hurricane catastrophe modeling, and data analysis will participate in the project.

Schedule

Task 1. Project Kickoff Meeting

- October 9, 2013

Task 2. Development of Sampling Plan

- Final Sampling Plan: February 21, 2014

Task 3. Development of Inspection Form

- Draft: December 6, 2013 (version 1)
- Final: January 27, 2014 (version 5)

Task 4. Review of Inspection Results and Development of Characteristics of Population of Properties

- Final Delivery of Inspection Data to ARA: June 8, 2015

- Final Report: September 16, 2015

Task 5. Review of Inspection Results for CPIC Insured Properties

- 12 business days after receipt of current Citizens data for Monroe County

Task 6. Deleted.

Task 7. Final Report

- Up to 3 weeks after receipt of a single, consolidated set of comments from FIRM on the final report. Comments must be provided to ARA no later than November 30, 2015.

Task 8. Preparation of Unicede/PX (UPX) Input Files

- 10 business days after receipt of current Citizens data for Monroe County

Task 9. Preparation of Florida Public Model Input Files

- 10 business days after the later of receipt of current Citizens data for Monroe County or the execution of contract modification #2.

Fees

The following firm fixed price fees will be invoiced to FIRM upon completion of each task:

Task	Description	Fee
1	Project kick-off meeting	$8,200
2	Develop statistical stratified sampling plan	$22,400
3	Develop inspection form	$7,400
4	Develop distribution of building and siting characteristics	$17,400
5	Review existing inspection result for CPIC-insured properties	$6,400
6	Deleted	$0
7	Final report	$12,300
8	Prepare Unicede/PX (UPX) Input Files	$5,600
9	Prepare Florida Public Model Input Files	$4,800
	Total	$84,500

Data

FIRM will collect and provide the following data to ARA:

1. Current Citizens exposure data for Monroe County.
2. Current Monroe County tax assessor data, including valuations and all other fields relevant to hurricane wind and storm surge risk modeling.
3. Building code and flood insurance rate map adoption history for all relevant jurisdictions having authority within Monroe County.

Accepted by:

Francis M. Lavelle, Vice President

Applied Research Associates, Inc. (ARA)

Mel Montague, President

Fair Insurance Rates in Monroe (FIRM)

ATTACHMENT C

Solaria Design and Consulting, Inc.
Professional Services Agreement

PRELIMINARY AGREEMENT – December 17, 2013

PROFESSIONAL SERVICES AGREEMENT BETWEEN Solaria Design & Consulting, Co.

AND FAIR INSURANCE RATES IN MONROE

Fair Insurance Rates in Monroe, a Florida corporation, having its offices at 422 Fleming Street in Key West, Florida, 33040 ("FIRM"), and

Solaria Design & Consulting, Co., ("Contractor") a Florida Corporation with its address at 3000 Overseas Highway Marathon, FL 33050 agree as follows on this 17th day of December , 2013.

The Contractor agrees to provide services to the FIRM under the following terms and conditions:

I. DEFINITIONS

Administering Service Area/Unit means
Project Manager assigned by FIRM .

Contract Administrator means, acting personally or through any assistants authorized by the Administrator/Manager of the Administering Service Area/Unit.

Deliverables means all Plans, Specifications, Reports, Recommendations, and other materials developed for and delivered to FIRM by Contractor under this Agreement

Project means Windstorm Risk Remodeling Initiative .

Project name: Engineering Consulting, Building Survey Services and Sub-file No. RFQ12-03

II. DURATION

This Agreement shall become effective on October 30, 2013, and shall remain in effect until satisfactory completion of the Services specified below unless extended or terminated as provided for in this Agreement.

III. SERVICES

A. The Contractor agrees to provide engineering survey services of existing structures ("Services") in connection with the Project as generally described in Exhibit A as tasked in Task Orders.

FIRM retains the right to make changes to the quantities of service within the general scope of the Agreement at any time by a written order. If the changes add to or deduct from the extent of the services, the contract sum shall be adjusted accordingly. All such changes shall be executed under the conditions of the original Agreement.

B. Quality of Services under this Agreement shall be of the level of quality performed by persons regularly rendering this type of service. Determination of acceptable quality shall be made solely by the Contract Administrator.

C. The Contractor shall perform its Services for the Project in compliance with all statutory, regulatory and contractual requirements now or hereafter in effect as may be applicable to the rights and obligations set forth in the Agreement.

D. The Contractor may rely upon the accuracy of reports and surveys provided to it by FIRM except when defects should have been apparent to a reasonably competent professional or when it has actual notice of any defects in the reports and surveys.

E. The Contractor may only use degreed engineers or architects to perform inspections and each of them as well as any support personnel shall have taken part in the project training session mutually developed by the Contractor, FIRM and other project consultants/subcontractors.

IV. COMPENSATION OF CONTRACTOR

A. The Contractor shall be paid in the manner set forth in Exhibit B. Payment shall be made monthly, unless another payment term is specified in Exhibit B, following receipt of invoices submitted by the Contractor, and approved by the Contract Administrator.

B. The Contractor will be compensated for Services performed in addition to the Services described in Section III, only when the scope of and compensation for those additional Services have received prior written approval of the Contract Administrator.

C. The Contractor shall keep complete records of work performed (e.g. tasks performed/hours allocated) so that FIRM may verify invoices submitted by the Contractor. Such records shall be made available to the FIRM upon request and submitted in summary form with each invoice.

V. INSURANCE/INDEMNIFICATION

A. The Contractor shall procure and maintain during the life of this contract, such insurance policies, including those set forth in Exhibit C, as will protect itself and FIRM from all claims for bodily injuries, death or property damage which may arise under this contract; whether the acts were made by the Contractor or by any subcontractor or anyone employed by them directly or indirectly. In the case of all contracts involving on-site work, the Contractor shall provide to FIRM, before the commencement of any work under this contract, documentation demonstrating it has obtained the policies required by Exhibit C.

B. Any insurance provider of Contractor shall be admitted and authorized to do business in the State of Florida and shall carry and maintain a minimum rating assigned by A.M. Best & Company's Key Rating Guide of "A-" Overall and a minimum Financial Size Category of "V". Insurance policies and certificates issued by non-admitted insurance companies are not acceptable unless approved in writing by FIRM.

C. To the fullest extent permitted by law, the Contractor shall indemnify, defend and hold FIRM, its officers, employees and agents harmless from all suits, claims, judgments and expenses including attorney's fees resulting or alleged to result, to its proportionate extent, from any negligent, grossly negligent, reckless and/or intentional wrongful or tortious acts or omissions by the Contractor or its employees and agents occurring in the performance of or in breach of this Agreement.

VI. COMPLIANCE REQUIREMENTS

A. Nondiscrimination. The Contractor agrees to comply, and to require its subcontractor(s) to comply, with the nondiscrimination provisions of the FIRM RFQ for the Project and Florida Statute. The Contractor further agrees to comply with the nondiscrimination provisions of Monroe County Florida and Key West, Florida and to assure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity. The Contractor shall provide to FIRM, before the commencement of any work under this contract, documentation demonstrating it has the policies required by this Agreement.

B. Contractors Debarred, Suspended, or Proposed for Debarment. Contractor agrees to complete a Debarment form and comply, and to require its subcontractor(s) to comply with State Debarment rules.

C. Statement of Confidentiality. The Contractor agrees to execute any confidentiality agreement required by State law, FIRM or a State or quasi State agency, and that any information accessed or gained in performance of those duties that are required to be maintained confidential by state law will be maintained in absolute confidence and will not be released, discussed, or made known to any party or parties for any reason whatsoever, except as required in the conduct of duties required, or where disclosure is required by law or mandated by a court of law.

VII. WARRANTIES BY THE CONTRACTOR

A. The Contractor warrants that the quality of its Services under this Agreement shall conform to the level of quality performed by persons regularly rendering this type of service.

B. The Contractor warrants that it has all the skills, experience, and professional licenses necessary to perform the Services specified in this Agreement.

C. The Contractor warrants that it has available, or will engage, at its own expense, sufficient trained employees to provide the Services specified in this Agreement.

D. The Contractor warrants that it is not, and shall not become overdue or in default to the FIRM for any contract, debt, or any other obligation to the FIRM including real and personal property taxes.

E. The Contractor warrants that its proposal for services was made in good faith, it arrived at the costs of its proposal independently, without consultation, communication or agreement, for the purpose of restricting completion as to any matter relating to such fees with any competitor for these Services; and

no attempt has been made or shall be made by the Contractor to induce any other firm to submit or not to submit a proposal for the purpose of restricting competition.

VIII. OBLIGATIONS OF FIRM

A. FIRM agrees to give or assist the Contractor access to partner consultants and the Project data and other identified data as required to perform the necessary Services under this Agreement.

B. FIRM shall notify the Contractor of any defects in the Services of which the Contract Administrator has actual notice.

IX. ASSIGNMENT

A. The Contractor shall not subcontract or assign any portion of any right or obligation under this Agreement without prior written consent from FIRM. Notwithstanding any consent by FIRM to any assignment, Contractor shall at all times remain bound to all warranties, certifications, indemnifications, promises and performances, however described, as are required of it under the Agreement unless specifically released from the requirement, in writing, by FIRM.

B. The Contractor shall retain the right to pledge payment(s) due and payable under this Agreement to third parties.

X. TERMINATION OF AGREEMENT

A. If either party is in breach of this Agreement for a period of fifteen (15) days following receipt of notice from the non-breaching party with respect to a breach, the non-breaching party may pursue any remedies available to it against the breaching party under applicable law, including but not limited to, the right to terminate this Agreement without further notice.

B. FIRM may terminate this Agreement if it decides not to proceed with the Project by notice pursuant to Article XII. If the Project is terminated for reasons other than the breach of the Agreement by the Contractor, the Contractor shall be compensated for work performed and authorized pursuant to this Agreement.

C. Contractor acknowledges that, if this Agreement extends for several fiscal years, continuation of this Agreement is subject to appropriation of funds for this Project. If funds to enable FIRM to effect continued payment under this Agreement are not appropriated or otherwise made available, FIRM shall have the right to terminate this Agreement without penalty at the end of the last period for which funds have been appropriated or otherwise made available by giving written notice of termination to the Contractor. The Contract Administrator shall give the Contractor written notice of such non-appropriation within thirty (30) days after it receives notice of such non-appropriation.

D. The remedies provided in this Agreement will be cumulative, and the assertion by a party of any right or remedy will not preclude the assertion by such party of any other rights or the seeking of any other remedies.

XI. REMEDIES

A. This Agreement does not, and is not intended to, impair, divest, delegate or contravene any constitutional, statutory and/or other legal right, privilege, power, obligation, duty or immunity of the Parties.

B. Absent a written waiver, no act, failure, or delay by a Party to pursue or enforce any rights or remedies under this Agreement shall constitute a waiver of those rights with regard to any existing or subsequent breach of this Agreement. No waiver of any term, condition, or provision of this Agreement, whether by conduct or otherwise, in one or more instances, shall be deemed or construed as a continuing waiver of any term, condition, or provision of this Agreement. No waiver by either Party shall subsequently effect its right to require strict performance of this Agreement.

C. The following provision(s) shall survive the termination of this Agreement:

Article V.

XII. NOTICE

All notices and submissions required under this Agreement shall be delivered to the respective party in the manner described herein to the address stated in this Agreement or such other address as either party may designate by prior written notice to the other. Notices given under this Agreement shall be in writing and shall be personally delivered, sent by next day express delivery service, certified mail, or first class U.S. mail postage prepaid, and addressed to the person listed below. Notice will be deemed given on the date when one of the following first occur: (1) the date of actual receipt; (2) the next business day when notice is sent next day express delivery service or personal delivery; or (3) three days after mailing first class or certified U.S. mail.

If Notice is sent to the CONTRACTOR, it shall be addressed and sent to:

Mr. Steven Grasley. P.E., President
Solaria Design & Consulting, Co
3000 Overseas Highway
Marathon, FL 33050

If Notice is sent to the FIRM, it shall be addressed and sent to:

FIRM

Heather Carruthers, President,
Fair Insurance Rates In Monroe
422 Fleming Street
Key West, FL 33040

XIII. CHOICE OF LAW AND FORUM

This Agreement will be governed and controlled in all respects by the laws of the State of Florida, including interpretation, enforceability, validity and construction, excepting the principles of conflicts of law. The parties submit to the jurisdiction and venue of the Circuit Court for Monroe County, State of Florida, or, if original jurisdiction can be established, the United States District Court for the Monroe County Florida, with respect to any action arising, directly or indirectly, out of this Agreement or the performance or breach of this Agreement. The parties stipulate that the venues referenced in this Agreement are convenient and waive any claim of non-convenience.

XIV.OWNERSHIP OF DOCUMENTS

Upon completion or termination of this Agreement, all deliverable work product prepared by, or project specific data obtained by the Contractor as provided under the terms of this Agreement shall be delivered to and become the property of FIRM.

Original basic inspection data, notes, sketches, charts, drawings, partially completed drawings, computations, quantities and other project specific data shall remain in the possession of the Contractor as instruments of service unless specifically incorporated in a deliverable, but shall be made available, upon request, to FIRM without restriction or limitation on their use. Reasonable fees for coordination, data retrieval & compilation, analysis, interpretation and delivery may be charged by the Contractor in providing the above if provided outside the scope of this project or the period of performance of this project.

FIRM acknowledges that the documents are prepared only for the Project. Prior to completion of the contracted Services FIRM shall have a recognized proprietary interest in the work product of the Contractor.

Unless otherwise stated in this Agreement, any intellectual property owned by Contractor prior to the effective date of this Agreement (i.e., Preexisting Information) shall remain the exclusive property of the Contractor even if such Preexisting Information is embedded or otherwise incorporated in materials or products first produced as a result of this Agreement or used to develop Deliverables. FIRM's right under this provision shall not apply to any Preexisting Information or any component thereof regardless of form or media, unless it is incorporated in a written deliverable for FIRM.

XV. CONFLICTS OF INTEREST OR REPRESENTATION

Contractor certifies it has no financial interest in the Services to be provided under this Agreement other than the compensation specified herein. Contractor further certifies that it presently has no personal or financial interest, and shall not acquire any such interest, direct or indirect, which would conflict in any manner with its performance of the Services under this Agreement.

Contractor agrees to advise FIRM if Contractor has been or is retained to handle any matter in which its representation is adverse to FIRM. FIRM's prospective consent to the Contractor's representation of a client in matters adverse to FIRM, as identified above, will not apply in any instance where, as the result of Contractor's representation, the Contractor has obtained sensitive, proprietary or otherwise

confidential information of a nonpublic nature that, if known to another client of the Contractor, could be used in any such other matter by the other client to the material disadvantage of FIRM. Each matter will be reviewed on a case by case basis.

XVI. SEVERABILITY OF PROVISIONS

Whenever possible, each provision of this Agreement will be interpreted in a manner as to be effective and valid under applicable law. However, if any provision of this Agreement or the application of any provision to any party or circumstance will be prohibited by or invalid under applicable law, that provision will be ineffective to the extent of the prohibition or invalidity without invalidating the remainder of the provisions of this Agreement or the application of the provision to other parties and circumstances.

XVII. EXTENT OF AGREEMENT

This Agreement, together with any affixed exhibits, schedules or other documentation, constitutes the entire understanding between FIRM and the Contractor with respect to the subject matter of the Agreement and it supersedes, unless otherwise incorporated by reference herein, all prior representations, negotiations, agreements or understandings whether written or oral. Neither party has relied on any prior representations, of any kind or nature, in entering into this Agreement. This Agreement may be altered, amended or modified only by written amendment signed by the Contractor and FIRM.

FOR FAIR INSURANCE RATES IN MONROE

12/19/13

By Heather Carruthers, President, FIRM Date

FOR CONSULTANT TO FAIR INSURANCE RATES IN MONROE

By

12/19/13

Steven Grasley, P.E. President, Solaria Design & Consulting Co. Date

ATTACHMENT D

Data Collection Methodology
FIRM Wind Study

Sample Population

The population included single-family homes, duplexes, town homes and condominiums without a communal entry. Excluded were mobile homes, condominiums with communal entrances, apartment buildings, commercial buildings and government building structures.

Sampling Frame

Applied Risk Associates (ARA) was selected through a Request for Qualifications (RFQ) process to perform risk engineering consulting services. There were three respondents to the RFQ and ARA was deemed by the Fair Insurance Rates in Monroe (FIRM) Board of Directors to be the most qualified for the task.

ARA's first task was to develop a sampling plan approach and acceptable sampling tolerance and confidence level.

The second task was to implement the sampling plan. A stratified random sample of homes was selected from the Monroe County Property Appraiser's (MCPA) 26,723 homes in the 2013 MCPA database designated as Property Class 0100 (residential). There were 32 strata defined by eight building eras (1800-1940; 1941-1961; 1962-1976; 1977-1983; 1984-1992; 1993-2002; 2003-2007; and 2008-2013); two categorical geographical locations (Key West and "not Key West"), and by quartile of assessed building values (top quartile or within the lower three quartiles).

ARA tasks also included the review of inspection results, the development of characteristics of population properties and the comparison of inspection results to the

existing Citizens Property Insurance Corporation's (Citizens) Monroe County book of business.

Sample Size

The sample size was calculated using MCPA's 26,723 homes in the MCPA database designated as Property Class 0100 and existing policy information drawn from Citizen's Monroe County book of business. Using a weighting system to ensure true proportional representation, a total sample size goal of 700 was calculated for statistical confidence as well as due to budget constraints. The study ultimately yielded data for 699 homes spread proportionately across all 32 strata including geographical locations and assessed property value quartiles. Each home was assigned an ID number used to identify survey participants while maintaining confidentiality of data as required by Florida State Statute.

Development of Inspection Form

ARA developed an inspection survey and procedure for use by trained engineering inspectors when conducting inspections. The survey included primary and secondary characteristics of residential properties as well as other site and insurance data. A copy of the survey template is stored with the FIRM Project Manager (PM).

Data Collection

Solaria Design and Consulting Co. (Solaria) was selected through a Request for Qualifications (RFQ) process to perform inspection and data collection services. There were three respondents to the RFQ, and Solaria was deemed the most qualified for the task. Solaria was originally assigned the task of scheduling as well as conducting

inspections while FIRM was to make "first contact" with homeowners. Because scheduling the first 100 inspections necessitated approximately 4 to 5 attempts to contact each homeowner prior to making an appointment for inspection, it was agreed that FIRM administrative staff would perform subsequent scheduling for the remaining sample. Initial inspections started in April 2014.

Solaria performed 699 inspections and submitted the results to the PM for quality control (QC) checks. QC checks were performed throughout the process, beginning with the first 100 inspections. That initial step identified two primary issues that required changes to the inspection survey. Hence, two versions—Version 1 (Exhibit 1) and Version 2 (Exhibit 2)—of the survey exist.

Selection of Random Structures to Inspect

Each stratum listed the structures in the random order identified by ARA. The list included relevant MCPA data that included structure address and owner address, but no further contact information. Inspections of the sample were to be performed in the random order identified.

Contact Processes for First Contact of the Recommended Sample

It was expected that a significant number of owners contacted would agree to the inspection; however, that was not the case. The PM reviewed owner information for the first 700 random structures and any telephone or email contact information was identified and logged. A second attempt to identify contact information included seeking assistance from realtors. These efforts yielded contact information for 17 of the 700 (2.4%)

structure owners. Thirteen (1.8%) agreed and four (< 1%) refused to have their homes surveyed. Through further telephone, email and personal contact, the owners of 29 additional addresses agreed to be surveyed. This homeowner information was listed in a Microsoft Access database for future use while scheduling inspections.

Based on the very limited amount of actual contact information that was obtained, it immediately became clear that the effort would be difficult and might result in very few inspections. A marketing and mailing program was developed that included press releases, informal radio spots, Facebook, Twitter, outreach to community groups and municipalities, and email notices using Constant Contact.

Direct Mailing

The next attempt at initial contact for the remaining 683 structure owners in the random list who had not replied was through a direct mailing. As homeowners declined (or did not respond to the request), an additional wave of addresses in the specified random order of each stratum would receive a mailing. Respondents from that group would be contacted when their random order inspections were warranted. If there were more respondents than positions left to be inspected in the stratum, the structures were selected for inspection in the original random order and the others left un-inspected.

Subsequently, an electronic letter and survey were sent via Constant Contact to 3,000 people who were thought to live or own property in Monroe County. The letter (Exhibit 3) asked people to volunteer their phone number, email address, and home address. There were 251 responses, and 51 properties fell within the initial 10% of the entire

Monroe County sample population. Of the 3,000 or so sent the Constant Contact survey, 815 people (27%) opened the email, 426 opened and looked in the survey, 405 (49%) clicked through the survey, and 251 completed the survey volunteering the requested information. The remaining accumulated data were stored in the database for future use, if required.

On March 14, 2014, 800 invitations to participate in the survey (Exhibit 5) were mailed via United States Postal Service (USPS) to Mail Group 1 (the first 800 structures in the sampling order), resulting in a response rate of 2%. Those responding positively were called "volunteers." All volunteers were checked for ranking in the random list and only when the homeowner listed directly above had failed to respond or responded negatively, was the volunteer then deemed "approved for inspection."

Five days later on March 19, 2014, letters were mailed to the next 1,200 owners in the random survey list identified as Mail Group 2 resulting in a poor (1%-2%) response rate. It was noted that many letters were returned with foreign addresses, moved/no forwarding address, or undeliverable.

Additional letters were mailed over a 4-week period (Mail Group 3) to the street addresses of structures whose owners had previously been unresponsive to earlier letters mailed to the homeowners' mailing addresses of record. This effort also had a less than 2% response rate.

On May 1, 2014, a mailing to 120 homes was sent primarily to Key West addresses in stratum categories that were almost full to the survey's requirement with the goal of reaching the stratum's identified target capacity.

By May 24, 2014, 94 homeowners had agreed to have their homes inspected (13.5% of the goal).

Because of the cost and time required to prepare and send letters, a postcard was developed which conveyed a brief message and provided a website, email address and phone number for further contact.

Between May 28 and June 5, 10,000 postcards (Exhibit 6) were mailed to Mail Group 4. Again FIRM received a low response and a large number of returned postcards. Over a 4-day period starting September 1, 2014, 11,700 additional postcards were mailed to Mail Group 5. These cards were addressed to both the identified homeowner "or current homeowner" as required by the postmaster for bulk mailings.

Database

A database was maintained for all contacts. It contained data regarding mailing dates, processes, first contact dates, and method of contact. It also identified offshore homes, returned mail, no such address, attempts at different mailing addresses, volunteers who were rejected as not being in the population, and unresponsive contacts. All phone or email contact with anyone was logged by scheduling staff or the database administrator.

Measurement and Systematic Error

Completed surveys were checked for accuracy by the PM. Most errors were those of inconsistent data (i.e. some responses were logged in incorrect units of measurement or incorrect exposure categories) and were corrected as necessary when returned to Solaria for clarification. During the QC process the PM, Solaria and ARA met to clarify and concur with the process for QC and data cleaning for future use by ARA.

Survey and Data Collection Design Considerations and Limitations

General considerations. The random sampling plan identified a number of homes in Each stratum. If a homeowner rejected inclusion in the survey, the next home in the stratum was selected. The following study considerations were noted:

- Due to the predominance of absentee homeowners, the probability was diminished that the property owner was the receipient of the mailed notice.
- Where the absentee homeowner was listed as a confidential homeowner (i.e. member of law enforcement), the physical address was unavailable for mailing.
- Invitations were not mailed to homeowners with addresses on offshore islands (accessible only by boat) or living abroad.
- Some of the ranked structures were townhome condominiums used as vacation rentals creating access problems.
- Contact or scheduling with the owner was difficult possibly due to the proliferation of cell phones and reduction in land lines with listed telephone numbers.
- Some structures in the survey population were owned by trusts and some by corporations creating contact and acceptance issues.

- Current absentee owners of homes that had been sold since the MCPA data file was obtained could not have received mailings to the owners' mailing addresses.
- Solaria insisted that engineering licensing standards mandate the use of elevated professional rigor for each inspection. No assumptions were made regarding any survey questions, and decisive evidence for survey determinations was required.

Survey design limitations. The survey instrument template was developed with the expectation that the resulting data from each survey question could be individually used by a number of catastrophe modeling firms. However, each model may use slightly differing definitions for the generally specified questions. An excessive amount of work would have been required to design a template responsive to each model's separate input requirements. Therefore, attendance to this fact is important for data analysis. The following two examples highlight this issue.

- The number of floors of a structure may serve to calculate losses based on reduced footprint in one model but may make assumptions concerning roof height in another model. The survey provided the data based on Florida Building Code (FBC) **definition of a first floor as "more than 6 feet above grade plane"** to provide a single point of reference. This, however, does not indicate that there is an enclosure or usable space on the first floor since homes are often built well above grade to comply with the National Flood Insurance Program (NFIP) Base Flood Elevation (BFE). The FBC definition of a floor used for this study is only six feet above grade plane; however, Citizens defines a first floor as long as it is eight feet above grade. Therefore, this data could be unsuitable for some models without further investigation of other survey questions, such as "finished floor elevation," "grade," and "bottom of lowest floor joist."

- Models that base terrain on the American Society of Civil Engineers (ASCE) 7-10 standard Exposure Categories would find results ready for input; however, models that use an older ASCE standard using only Exposure Categories B and C, or which use the FS 161.55(4) for its Exposure Category definition would need to modify inputs into the model. The survey response for "distance from the coast" would need to be clearly evaluated prior to terrain input in the model.

Regardless of the survey limitations, the collected study data is useful for this and future studies.

Data collection design limitations. Data collection difficulties were a result of both the difficulty in contacting property owners and their resistance to allowing strangers into their homes. In addition, the ability to obtain the required survey data from building departments and during site inspections was underestimated. Other systemic conditions which may cause a skewed result include:

- A higher percentage of owners may have responded positively if they believed they had high insurance costs which could skew the results toward older less mitigated homes, homes in Exposure C or D, or larger homes.
- Positive responses may be skewed toward owners who knew of FIRM, heard advertising spots, saw print or social media about the Study, and were therefore more like to open their homes for inspection.

Future Research

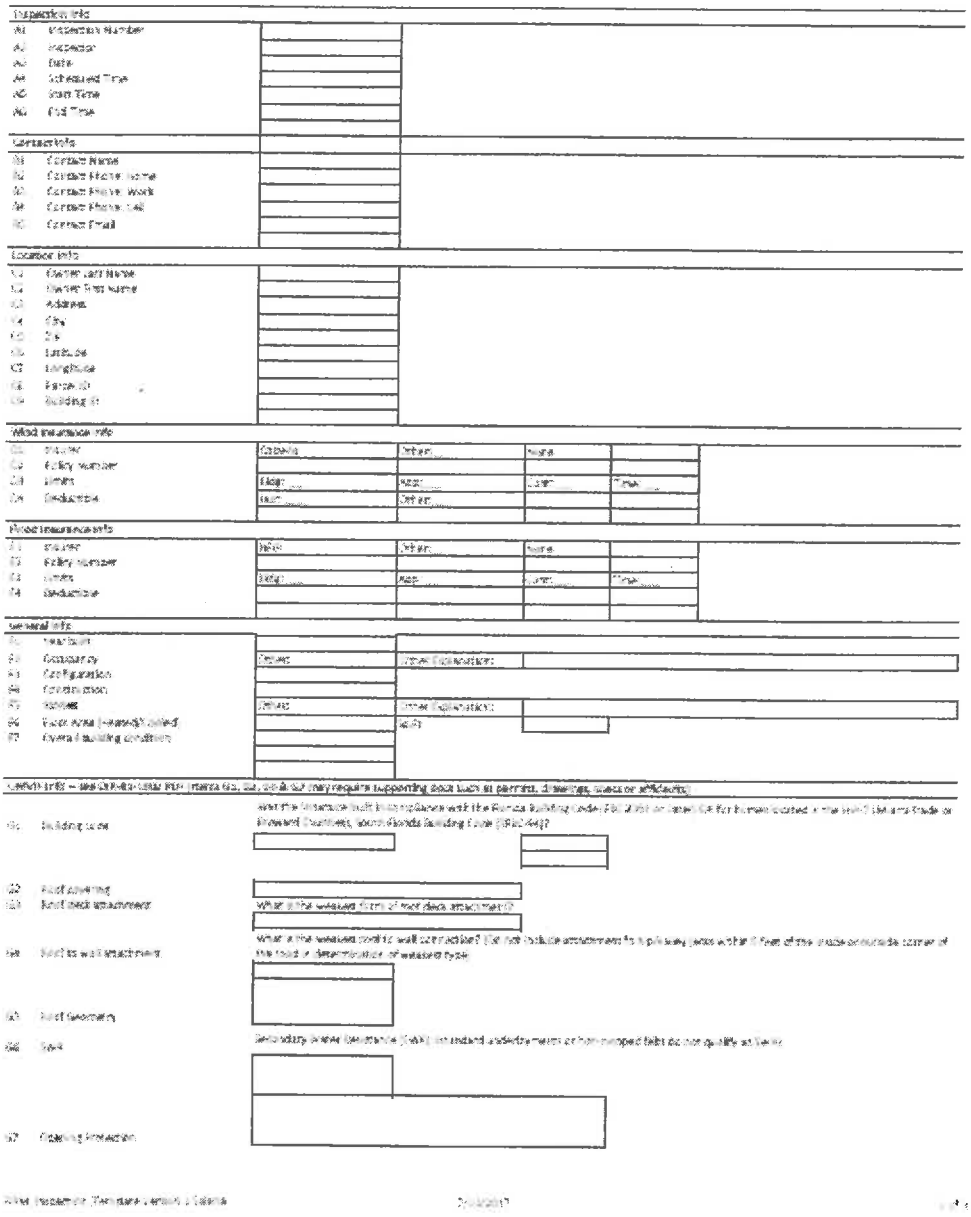
Future research to enhance understanding of the vulnerability of the building stock in the Keys may include research to reduce the number of "unknown" or "uninspected"

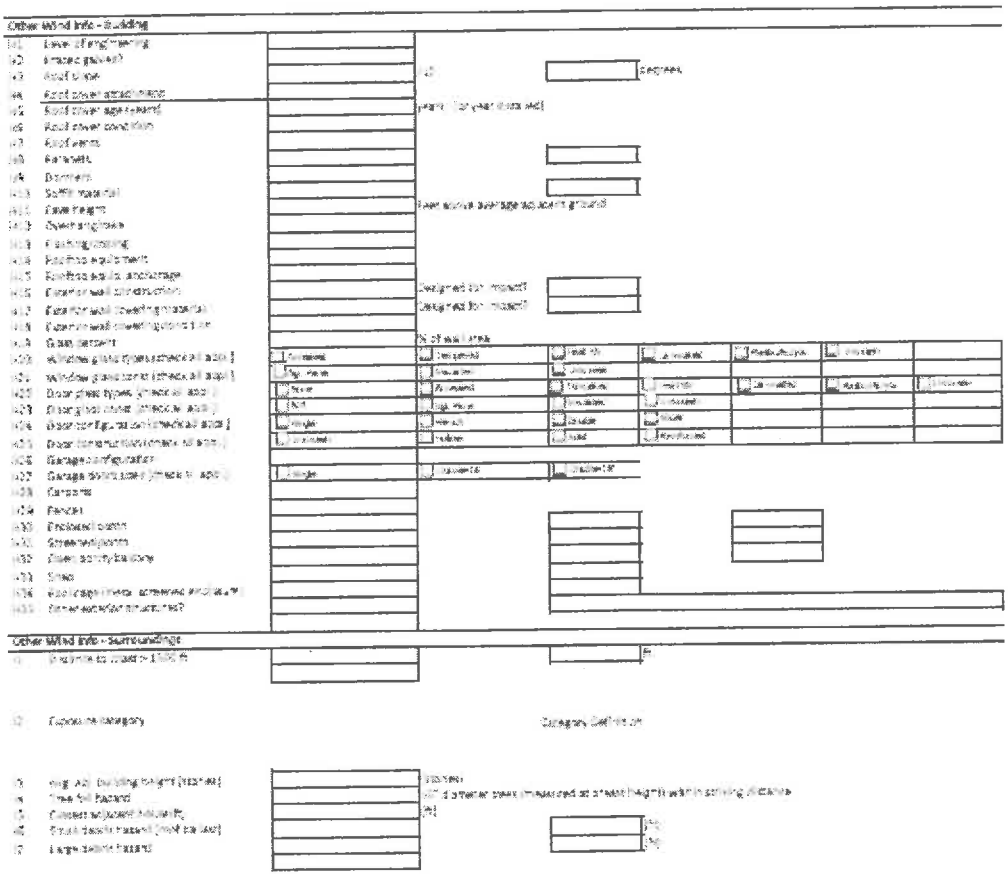
elements of the 699 surveyed homes. Building department files may be searched for design wind loads and professional certifications. Local municipalities may be tasked with securing structural information during future inspections for building permits opened for improvements.

It would be helpful to compare the pre-study and post-study estimated standard errors (relative uncertainty) in expected hurricane wind losses by year built stratum.

The comparison of five or more models using each model appropriate input would increase the understanding of how models represent the building stock and meteorology of the Florida Keys.

Exhibit 1: Version 1 Survey Template Form





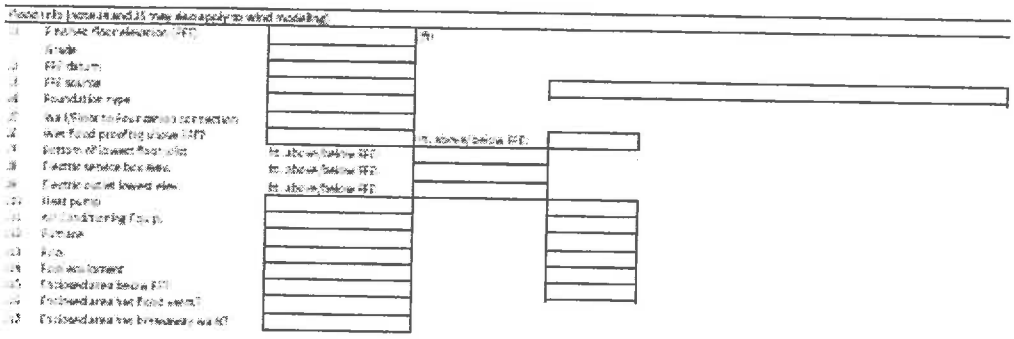
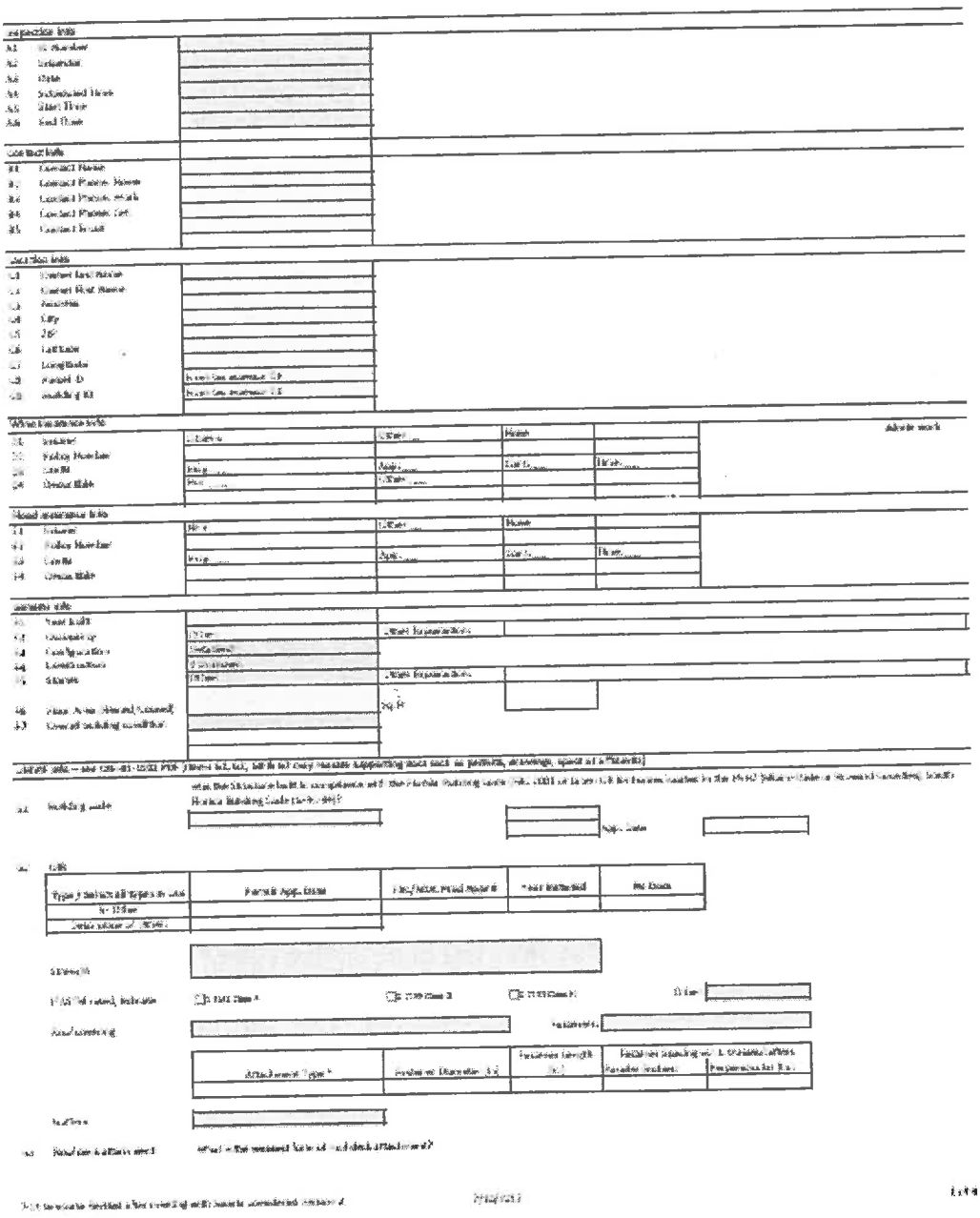
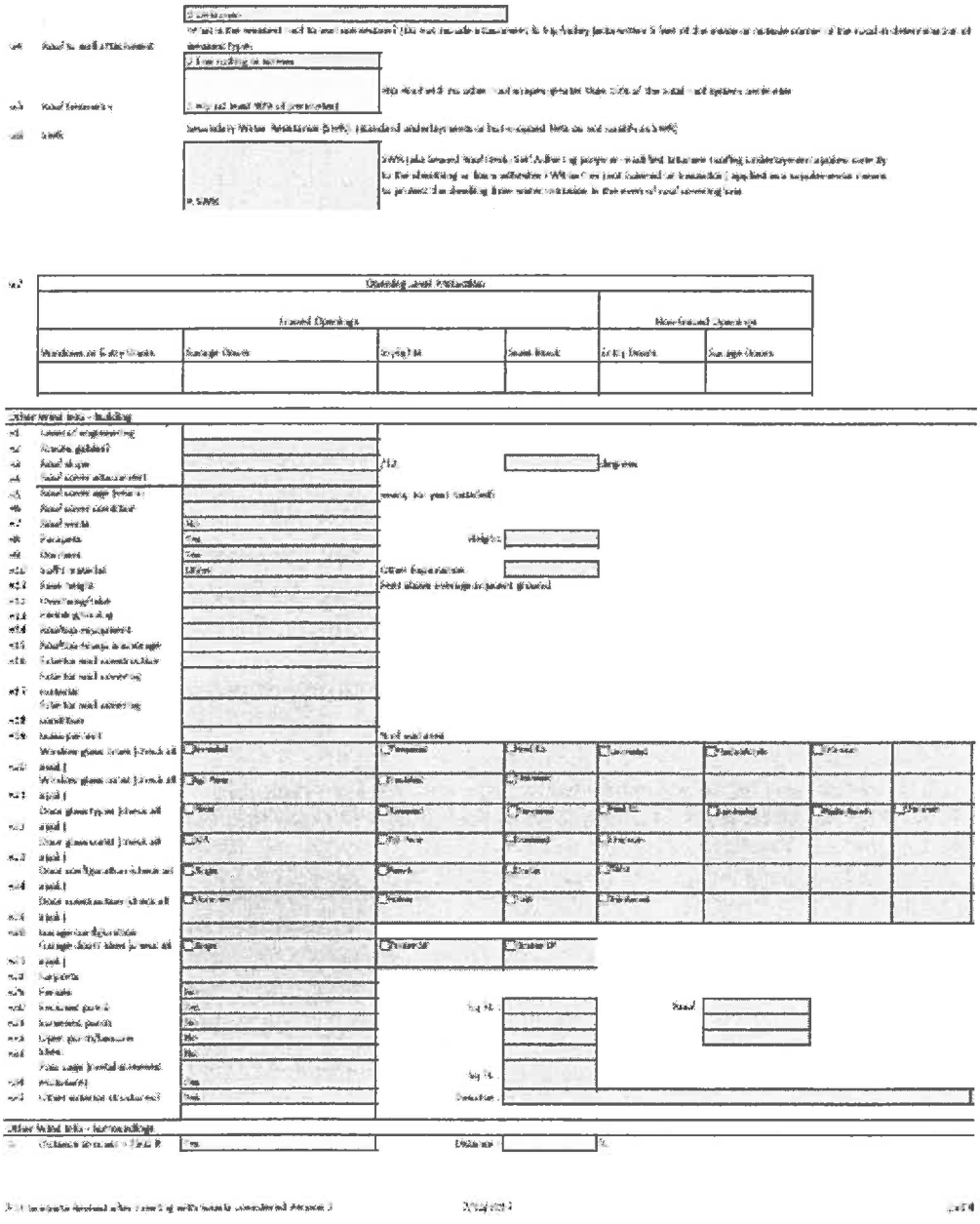
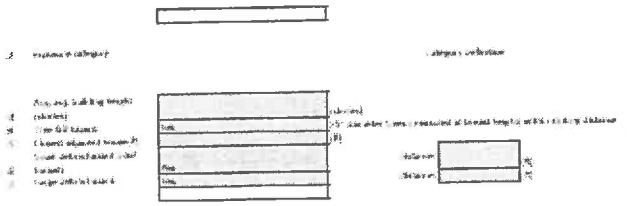


Exhibit 2: Version 2 Survey Template Form







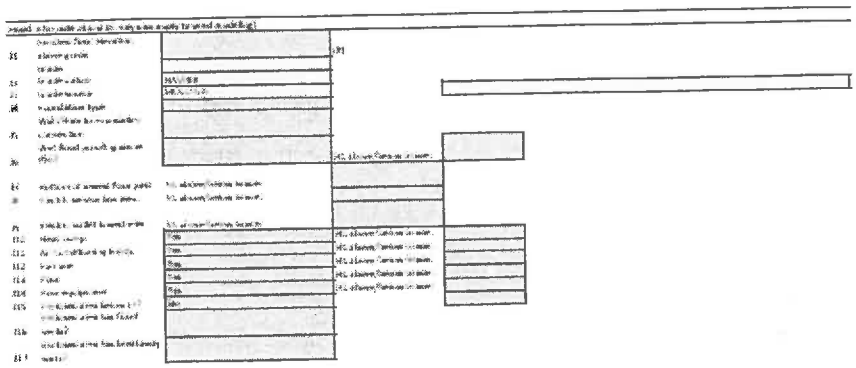


Exhibit 3: Electronic Letter

Dear FIRM Friends and Members,

Please help us to complete the Wind Analysis Survey.

As you are aware FIRM is conducting a study to look at 704 homes in the Keys to determine the wind worthiness of Keys homes. The results of the study will help to clarify what is used in wind insurance ratemaking for Monroe. The study is performed by architects and engineers and confidential and the homes selected were selected randomly from the county property appraiser database. As such, we have only addresses and *not* phone numbers to contact people. We have mailed over 1000 letters to the initial selected homes and will be mailing 2000 this week since not everyone contacted is willing to be part of the survey. The random process means we must start at the top of the computer generated list and work our way down until 704 inspections are complete.

In an effort to match selected homes with telephone numbers to contact owners we are asking you to complete the survey below. If your home is on our inspection list we will contact you via USPS mail, email or telephone to schedule an appointment.

More information about the project is available in our mailing and on our website www.FIRMKEYS.org.

By completing this email survey, I agree I am *either* agreeing to be part of the study and have a representative call me or I am choosing to decline to be part of the study.

Question 1: I wish to be part of the FIRM study Yes____ No____
Question 2: First and Last Name: _____
Question 3: Zip Code: _____
Question 4: City: _____
Question 5 Street Address: _____
Question 7: Email Address: _____
Question 8: Phone number: _____
Question 9: Alternate Phone: _____
Question 10: Managing Agent or tenant if you are not available: _____

Exhibit 4: Frequently Asked Questions

Wind Insurance Cost Reduction Study

Frequently Asked Questions

Why the project?

We believe our indicated windstorm insurance rates are too high, and we've been paying too much – but we need hard data to prove it.

What is the Project?

Basically, we are looking at the "mitigation" features of homes. Inspectors will determine if you have a new roof, roof to wall straps, shutters, nearby trees, how close your home is to the water, how tall, how high above flood, etc. Engineers and architects from Solaria Design in Marathon will perform the inspections, a bit more detailed than the mitigation inspections many folks have had. Solaria will collect the data and then risk engineers will estimate the strength of the homes based on what is found in the homes inspected. An analytics firm will tell us what rates we could be paying if we stay with Citizens, or move to a commercial vendor, or if we develop a mutual company.

How did I get selected?

FIRM hired an engineering firm that specializes in wind vulnerability analysis. Their team gave us a list of ***randomly*** selected properties which they received from the Monroe County Property Appraiser's office. The data is public data available on the internet. We need to complete 704 inspections to get a statistically valid sample. The engineering firm also developed the questionnaire or survey tool that will be used in the inspections.

Is it *really* confidential?

Yes. The house-level data remains confidential. The engineers will group the data by age of homes to develop a basis for assigning the resistance to each group. That grouped data will then be used to "fill in" the blanks for the 50,000 structures in the county. For instance, if 85% of the homes built in 1965 are found to have straps, then the study will "plug" 85% straps into a formula. Collectively, the County-wide results will be made public, and it will be compared to the results of current models. House-by-house data will not be made public and will not be shared with Citizens.

Do I need to do anything?

Just call us to agree to be in the study, make an appointment with Solaria when they call and be home for the appointment.

What about paperwork requested?

Paperwork that we would like to see is optional. If you have the data it will help provide more detailed information. If you do not have it, or do not want to look for it, do not fret. The inspector will have more than enough work to do without the added paperwork.

Do I pay for anything?

No. FIRM is funded through local donations. The study is funded by a grant from Citizens Insurance.

Who is FIRM?

Fair Insurance Rates in Monroe (FIRM) is your local grassroots non-profit (501c-4) insurance consumer advocacy group. We've been working for eight years to try and keep windstorm insurance affordable here. We have made great strides in rolling back wind rates and keeping increases to 11% per year. This year we added flood insurance issues to our mission and helped prevent outrageous increases in flood premiums that would have resulted from Biggert-Waters, a bill that Congress passed in 2012.

Why does FIRM think this is going to help?

We know that Monroe County has the toughest building code in Florida, and has for a long time. We have learned that the real stumbling block to fair rates here in the Keys lies with the computer "models" used to predict insurance premiums. They simply don't account for the way we build because they don't have accurate data on the construction characteristics of our homes. They also don't account for the height of the homes. Insurers suggest that if we can prove our homes are strong, our indicated rates could go down, and other insurers may come to the Keys or offer competitive rates.

I don't have insurance, why should I help?

Whether you own your home, rent your home, have insurance or don't, have a mortgage or don't, this issue impacts you. Property insurance significantly drives up the cost of home ownership and rents alike. If you want to sell your home, and insurance costs are high, you will see lower sales prices. It makes it far more difficult to sell homes here, and far more costly for people, especially our workforce, to live here.

How will I know the inspector is FIRM's inspector?

We have assigned a unique code number to each house. That will keep the house confidential after the inspection by "hiding" the actual location of the home. You and the inspector will have that number. When he or she arrives you can ask what your number is and verify it using the code on the envelope you will receive in the mail from FIRM.

Who can I speak to?

We ask that you contact us to discuss the inspection process and your willingness to partake in the project. **Please call (305) 294-3476 or email firmkeys@gmail.com**. We are happy to answer any questions you may have about the Project or the inspections themselves.

Do I need to do anything to help make the inspection short and sweet?

To ensure a smooth inspection process, we have provided a checklist attached to our letter to you (see below). **You do not *need* to have this information or take action,** but you can help make the process run more smoothly if you can prepare for the inspection. This information can potentially fill in otherwise unknowable data, or it can eliminate assumptions and provide more clarity to obvious data. We also request that, if you are able, please prepare access to the underside of the main roof or attic for the inspector.

Do we appreciate your help?
Yes! We have worked for years to get to this point and appreciate your help. This is an opportunity for us to take matters into our own hands and develop a sustainable solution to the windstorm insurance crisis. *Please call now to let us know if we can count on you to help us fight for lower insurance rates.* If you do not have insurance, remember that those purchasing your home in the future may need it, and many of your neighbors are required to have insurance if they have a mortgage. Your assistance is vital to save Keys homeowners many millions of dollars each year. Thank you for helping us to help you.
Learn more about this study and the firms conducting it. Visit:
www.firmkeys.org
www.ara.com/Offices/NC_intrarisk.htm
www.solariadesign.com

MONROE COUNTY WINDSTORM RISK RE-MODELING INITIATIVE

Exhibit 5: Letter Sent as Part of Mailing 1

March 14, 2014

Re: Wind Insurance Cost Reduction Study

Dear Homeowner,

Congratulations! You have been randomly selected to participate in a study to reduce your windstorm premiums and help improve the economy of the Keys long-term.

Fair Insurance Rates in Monroe (FIRM) is your local grassroots non-profit insurance consumer advocacy group. We've been working for eight years to try and keep windstorm insurance affordable here. In that time, we've learned that the real stumbling block to fair rates here in the Keys lies with the models used to predict insurance premiums. They simply don't account for the way we build because they don't have accurate data on the construction characteristics of our homes. We believe we've been paying too much – but we need hard data to prove it. *That's where you come in.*

Whether you own your home, rent your home, have a mortgage or don't, this issue impacts you. Property insurance significantly drives up the cost of home ownership and rents alike, and it's making it far more difficult to sell homes here, and far more difficult for the folks who sustain our community – teachers, EMTs, landscapers, police officers, servers, etc. – to remain here. Finding an alternative to the current options for coverage is vital to our future.

Towards this effort, FIRM requested and received funding for a Windstorm Analysis Project to collect that hard data, to help verify the true strength of Keys homes and compare that to what's used in wind insurance rate calculations. *The goal is to find a more affordable, fair, long-term solution for wind insurance.* FIRM has engaged the risk analytics firm ARA Intrarisk, and the local Marathon engineering firm, Solaria Design and Consulting, to assist with data collection and analysis.

Your home is one of 700 that has been randomly selected from the Property Appraiser Data Base to be inspected in this CONFIDENTIAL study. We ask that you open your home to FIRM and Solaria for this wind vulnerability assessment.

We understand that you may be apprehensive. Please know that **the data collected will not be shared by address with Citizens Property Insurance, any other insurance company or local government authorities and cannot be used to increase your rates**

or compromise your home in any way. Your insurance company will not see the results of the inspection of your home. The data will be aggregated and analyzed to create a profile of Monroe County's building stock, not to influence individual premiums. In fact, based on data we've seen over the past eight years, we're optimistic that this will lead to lower premiums for all of us.

ARA developed a random statistical method to select homes for inspection and prepared an inspection tool to gather data in a meaningful yet efficient manner. Solaria, on behalf of FIRM, will perform the actual inspections – not Citizens or their representatives. Solaria will be looking at attics, eaves and roofs, and taking measurements of building heights, shutters, windows, etc. The inspection is expected to last 1 to 1-1/2 hours. (The length of the inspection can be reduced if the home is prepared ahead of time and any helpful paperwork is available for use.)

We ask that you contact us to discuss the inspection process and your willingness to partake in the project. **Please call (305) 294-3476 or email firmkeys@gmail.com**. We are happy to answer any questions you may have about the Project or the inspections themselves.

To ensure a smooth inspection process, we have provided a checklist on the attached page to help you or the occupant/agent to prepare for the inspection. This information can potentially fill in otherwise unknowable data, or it can eliminate assumptions and provide more clarity to obvious data. We also request that, if you are able, please prepare access to the underside of the main roof or attic for the inspector.

This is an opportunity for us to take matters into our own hands and develop a sustainable solution to the windstorm insurance crisis. *Please call now to let us know if we can count on you to help us fight for lower insurance rates.* If you do not have insurance, remember that those purchasing your home in the future may need it, and many of your neighbors are required to have insurance if they have a mortgage. Your assistance is vital to save Keys homeowners many millions of dollars each year. Thank you for helping us to help you.

Sincerely,

Heather Carruthers
President, Fair Insurance Rates in Monroe
Monroe County Commissioner, District 3

Learn more about this study and the firms conducting it. Visit:
www.firmkeys.org
www.ara.com/Offices/NC_intrarisk.htm
www.solariadesign.com

Inspection Process

- We'll contact you by letter or phone call
- You'll be contacted again via post card, letter or phone call
- You'll get back to us by phone, email or post designating the person to be contacted for inspection coordination.
- We'll provide a checklist to prepare for the event and Solaria Design will contact you or your designee to schedule the inspection day and time. We'll provide instructions and how to prepare for the inspection.
- Solaria will call one to two days ahead of the inspection as a reminder, and provide a clear time schedule for arrival. They'll include your individual property random identifier (see the top of this letter).
- The Solaria representative will arrive with a name tag, and identify your property with the same random identifier. That will help ensure the representative is truly representing FIRM.

Preparation for Inspection

To ensure a smooth inspection process we have developed a checklist for the owner/occupant/agent of the property to prepare for the inspection. This information can potentially fill in otherwise unknowable data, or can eliminate assumptions and provide more clarity to obvious data.

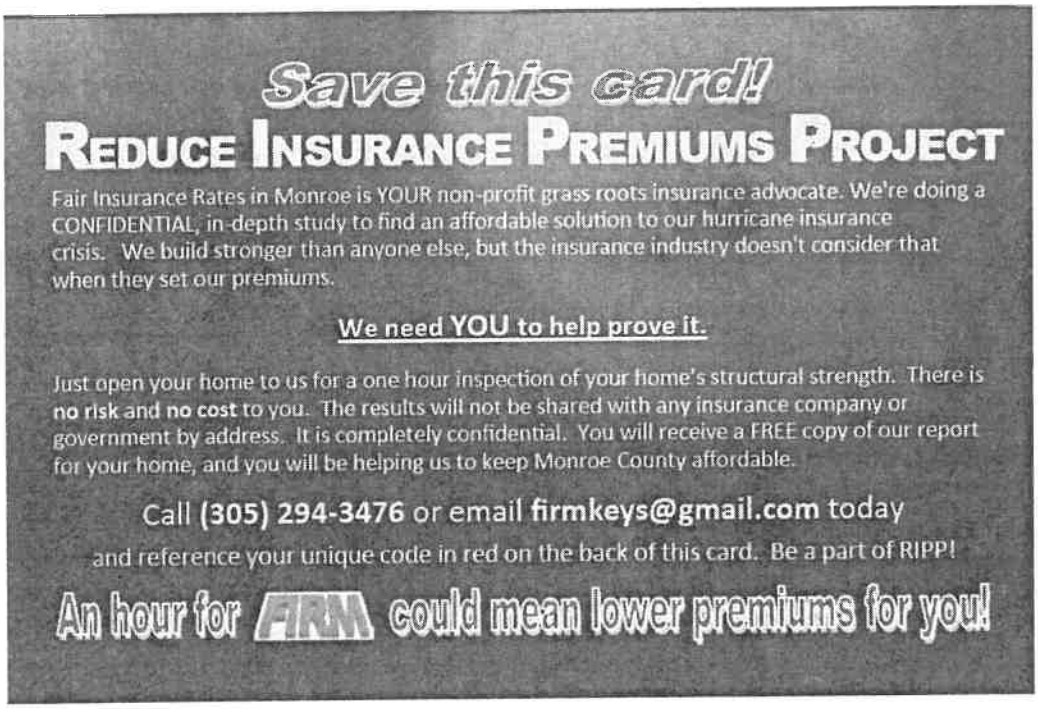
In advance gather information such as:

- ☐ Insurance forms
- ☐ Flood Elevation Certificates
- ☐ Receipts for work on roofs, shutters, wind-resistant windows, etc.
- ☐ Permits for relatively recent or important work such as shutters, re-roofs, additions, impact windows
- ☐ Blueprints

If you are able, clear the attic hatchway to make room for the inspector to look at the roof-to-wall connections and roof structure. If you have a ladder than can remain in place, leave it for the inspector to use.

If you know of the best location to see the roof deck and truss or rafter system, through a scuttle, window, or from a porch or grade, please make that accessible and let the inspector know about the spot.

Exhibit 6: Double-sided Postcard



FIRM

Fair Insurance Rates in Monroe
422 Fleming Street, #5
Key West, FL 33040

Be a part of the RIPP. There is no cost and no risk to you. All we ask is an hour of your time for an inspection by an independent, local company to verify what we already know — that we build strong homes in the Keys. All it can do is help you and your neighbors save money.

Your home has been randomly selected to be part of this project. Please call (305) 294-3476 or email us at firmkeys@gmail.com for more information and to volunteer. Use the CONFIDENTIAL code in red to the right to identify your property. Learn more at www.firmkeys.org. Thank you for helping to be part of the solution!

ATTACHMENT E

ARA Final Report
Sampling Plan and Analysis of Survey Results for Residential Properties in Monroe County, Florida

Sampling Plan and Analysis of Survey Results for Residential Properties in Monroe County, Florida

Final Report

September 16, 2015

Prepared for:

Fair Insurance Rates in Monroe (FIRM)
422 Fleming Street
Key West, FL 33040

Prepared by:

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8537 Six Forks Road, Suite 600
Raleigh, NC 27615

ARA Project No.: 002041

Table of Contents

1. Introduction

This report summarizes risk engineering consulting services provided by Applied Research Associates, Inc. (ARA) to Fair Insurance Rates in Monroe (FIRM) during the period from October 2013 through September 2015.

The stated goal of the *Monroe County Windstorm Risk Remodeling and Analysis Initiative* (FIRM 2012) is to "develop an accurate wind risk profile for the Keys. This will include distinguishing between predicted hurricane damage attributable to wind versus storm surge, and incorporating accurate, validated data regarding the quality of wind-resistant construction throughout the County."

To accomplish this goal, FIRM requested and received funding from Citizen Property Insurance Corporation to conduct a three-part project (FIRM 2012):

1. "**Vulnerability Study** - Designed to verify the quality and characteristics of building stock in Monroe County.
2. **Windstorm Risk Study** - Designed to verify the reduced windstorm risk from storm surge on the Citizens book of business in Monroe County.
3. **Natural Catastrophic Analysis** - Designed to complete an independent analysis of the Citizens book of business and options for alternate insurance structures."

Within the **Vulnerability Study** portion of the overall project, the FIRM project plan includes two separate components (FIRM 2012):

a. ***Survey Tool:*** "A properly developed sample and survey tool will be created which shall identify a minimum set of properties for review and inspection. The survey tool is a form and provides guidance on what to look for and collect when inspecting each of the properties in the sample to ensure consistency and accuracy. The survey tool will be developed by a PhD Professional Engineer experienced in risk and reliability engineering with respect to wind. The sampling and inspection tool shall be used by an engineer(s) to complete the survey. … The final written report will include the results of the inspection program, a summary of the conclusions, data collected, and analysis of the data."

b. ***Inspections:*** "Inspection will be performed by licensed Professional Engineers and the process will be designated by the PhD Professional Engineer. The result will be a distribution of building characteristics and siting characteristics which can be compared to the current model inputs and can be used for additional modeling runs."

This report documents the development of the survey tool, provides a summary of the data collected by the inspection contractor (Solaria Design & Consulting Company), and provides a statistical analysis of the inspection results.

2. Survey Tool Design

The survey design includes four components: (1) the survey form, (2) the survey population data, (3) the survey stratification variables, and (4) the survey sampling plan. These components are described below.

2.1 Survey Form

The survey tool developed for this project builds on ARA's past wind mitigation survey and modeling experience and is designed to encompass the range of hurricane modeling inputs for residential structures currently supported by the commercial catastrophe model vendors. Important construction characteristics for wind loss were originally developed by ARA through the Florida Residential Construction Mitigation program and the 2002 and 2008 Florida wind mitigation studies (Twisdale et al. 2002, 2008). Wind loss variable include number of stories, roof geometry, types of connection, opening protection level, etc. Flood loss variables include finished floor elevations, type of foundation, and elevations of key building equipment items. Because many of these variables are categorical in nature, a key objective of the survey is to estimate the proportions of the Monroe County residential building stock that belong to each variable category (e.g., the fractions of homes with hip, gable, flat or other roof geometries).

Inputs currently supported by the four commercially-available hurricane models accepted under the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) standards were obtained from publicly available documents, including model documentation submitted to the FCHLPM in 2013. In cases where the models support different choices for the same input variable, consolidated lists were developed to represent the range of modeling options available across the commercially available hurricane catastrophe models. For example, for exterior wall covering material, the RMS model supports nine options, the AIR model supports eight options, the EQECAT model supports ten options, and the consolidated wall covering material list contains 14 options.

The final survey form developed for the inspections includes ten sections (A through J). The information analyzed for this project is in the last five sections (F through J). The final survey questions relevant to this analysis and their categories are summarized below:

A. Inspection information (for administrative purposes only)
B. Contact information (removed from data provided to ARA)
C. Location information (removed from data provided to ARA)
D. Wind insurance information (not collected)
E. Flood insurance information (not collected)
F. General information
    1. Year built
    2. Occupancy (one-family, two-family, other)
    3. Configuration (detached, townhouse)
    4. Construction (unknown, wood frame, unreinforced masonry, reinforced masonry, reinforced concrete, steel frame, light metal frame)

5. Number of stories (1, 1.5, 2, 2.5, 3, …)
6. Floor area (square feet heated or cooled)
7. Overall condition (unknown, poor, average, good)

G. Wind mitigation information (per the Florida OIR-B1-1802 form and the consolidated list of model options)
   1. Building permitted under the Florida Building Code? (yes or no)
   2. Roof covering (type (asphalt/fiberglass shingle, concrete/clay tiles, metal: v-crimp, metal: corrugated, metal: standing seam, metal shingle, metal tile, wood shakes, built-up roof with gravel, built-up roof without gravel, single ply membrane ballasted, single ply membrane, painted/sealed concrete), permit date, product approval number, year installed, attachment type and schedule, if visible)
   3. Roof deck attachment (unknown, battens, plywood/OSB with unknown connection strength, plywood/OSB with 6d nails or staples, plywood/OSB with 8d @ 6/12, plywood/OSB with 8d @ 6/6, plywood/OSB with 8d ring shank nails at 6/6, plywood/OSB with 10d@6/6, dimensional lumber or tongue and groove decking with less than 2 nails per board, dimensional lumber or tongue and groove decking with at least 2 nails per board, normal weight reinforced concrete, lightweight or gypsum concrete on plywood or metal decking, metal deck with insulation)
   4. Roof-to-wall attachment (unknown, toe-nailing or screws, clips, single wraps, double wraps, structural (bolted, welded, …), reinforced concrete slab integral with masonry wall)
   5. Roof geometry (hip, flat, gable, shed, mansard, gambrel, Dutch hip, complex, other)
   6. Secondary water resistance (yes, no, unknown)
   7. Opening Protection (7 choices per OIR-B1-1802 chart: A; B; C; N – unverified A or B; N – Other not A, B, or C; X (none); not applicable; unknown)

H. Other wind information
   1. Level of engineering (unknown, minimal, partial, full)
   2. Braced gables? (none, some, all, not applicable)
   3. Roof slope (pitch or angle)
   4. Roof cover attachment (unknown, staples, nails, screws, adhesive, mortar)
   5. Roof cover age (years or unknown)
   6. Roof cover condition (unknown, poor, fair, average, good, new)
   7. Roof vents (yes, no)
   8. Parapets (yes, no; height in feet if yes)
   9. Dormers (yes, no)
   10. Soffit material (wood, vinyl, other, none)
   11. Eave height (feet above average adjacent ground)
   12. Overhang/rake (none, <8", 8-12", 13-36", >36")

13. Flashing/coping condition (unknown, poor, average, good, good+ES1 compliant)
14. Rooftop equipment (unknown, no, yes)
15. Rooftop equipment anchorage (unknown, inadequate, adequate/engineered, not applicable)
16. Exterior wall construction (unknown, masonry, brick veneer, frame, reinforced concrete, other)
17. Exterior wall covering material (unknown, metal sheathing, wood clapboards, wood panels, aluminum, vinyl, hardboard, stucco, cement board, reinforced concrete, asbestos siding); Designed for impact (unknown, yes, no)
18. Exterior wall covering condition (unknown, poor, fair, average, good, new)
19. Glass percent (of exterior wall area)
20. Window glass types (annealed, tempered, heat strengthened, laminated, plastic, unknown – check all that are present)
21. Window glass construction (single pane, insulated, unknown – check all that are present)
22. Door glass types (none or same choices as H20)
23. Door glass construction (none or same choices as H21)
24. Door configuration (French, double, single, sliding glass – check all that are present)
25. Door construction (hollow, solid, reinforced, unknown – check all that are present)
26. Garage configuration (attached, detached, none)
27. Garage doors sizes (single, double-16', double-18' – check all that are present)
28. Carports (no, detached, attached)
29. Fences (yes, no)
30. Enclosed porch (yes, no; if yes, enter square feet and select integral or non-integral roof)
31. Screened porch (yes, no; if yes enter square feet and select integral or non-integral roof)
32. Open porch/balcony (yes, no; if yes ,enter square feet and select integral or non-integral roof)
33. Shed (attached, detached, no; if attached, enter square feet and select integral or non-integral roof)
34. Pool cage (metal screened enclosure) (yes, no; if yes, enter square feet)
35. Other exterior structures? (yes, no; if yes, describe)

I. Other wind information – surroundings
   1. Distance to coast > 1500 ft. (yes, no)
   2. Exposure category (B, C, D)
   3. Average adjacent building height (stories)
   4. Tree fall hazard (yes, no)

5. Distance to closest adjacent house (feet)
6. Small debris hazard (roof ballast) (yes, no)
7. Large debris hazard (yes, no)

J. Flood information
1. Finished floor elevation (feet above grade) and Grade elevation (feet above(below) datum)
2. Grade datum (NAVD88 for all)
3. Grade source (Monroe County GIS Department for all)
4. Foundation type (unknown, masonry basement, crawl space, slab, continuous footing, post & pier, pile)
5. Wall/floor to foundation connection (unknown, gravity/friction, nails/screws, hurricane ties, bolted, ½" anchor bolds at 6 ft. spacing, ½" anchor bolds at 4 ft. spacing, 5/8" anchor bolds at 6 ft. spacing, continuous structural connections (e.g., poured in place reinforced concrete))
6. Wet flood proofing above first floor elevation? (unknown, yes , no; if yes, enter feet above grade)
7. Bottom of lowest floor joist (feet above grade)
8. Electric service box elev. (feet above grade)
9. Electric outlet lowest elev. (feet above grade)
10. Heat pump (yes, no; if yes, enter feet above grade)
11. Air Conditioning Equipment (yes, no; if yes, enter feet above grade)
12. Furnace (yes, no; if yes, enter feet above grade)
13. Pool (yes, no; if yes, enter feet above grade)
14. Pool equipment (yes, no; if yes, enter feet above grade)
15. Enclosed area below first floor? (no, yes/storage, yes/living area; if yes, enter square feet)
16. Enclosed area has flood vents? (yes, no, or not applicable)
17. Enclosed area has breakaway walls? (unknown, yes, no, or not applicable)

Examples of the final survey form are provided in Appendix A.

2.2 Survey Population Data

The data source from which the survey sample was drawn is a November 2013 snapshot of the Monroe County Property Appraiser (MCPA) database. The database contains tax assessor data covering 91,199 parcels, of which 26,767 were coded with the single family property class description code (PC=100). Of the single family parcels, 44 parcels did not have a year built (YRBLT) value and/or a building (BLDG) value, leaving 26,723 parcels in the final population. Each parcel in the final population was then tagged according to the three stratification variables described in the next section: year built, location, and building value.

2.3 Stratification Variables

Stratification can be used to take advantage of *a priori* information and correlations of variables to maximize the information gained from surveys that are constrained by cost considerations. The benefits of using stratified sampling include decreased variance of sample estimates (i.e., higher confidence) and the ability to study strata individually. In a stratified sampling plan, the population is divided into mutually exclusive and collectively exhaustive homogeneous groups.

In general, buildings built within a few years of each other are more likely to have similar construction characteristics than those built further apart in time. For example, the type of roof deck, how it is fastened, the roof- to-wall connection, roof cover type, and even building shape are correlated to year built era. Using year built as the first stratification variable allows these correlations to be analyzed and also tested against the original strata. Based on a review of state and local building code ordinance history and local construction practices, the eight eras defined in Table 1 were selected for use in the sampling plan.

Table 1. Monroe County Building Code Eras

Era	Begin*	End	Key Wind and Flood Issues
1	2008	2013	Partially enclosed design option removed from FBC; Class H shingles introduced; FBC Residential; 2006 FIS adopted for flood
2	2003	2007	Florida Building Code goes into effect with ASCE 7-98 wind design map and wind exposures B and C
3	1992	2002	Expanded sets of wind pressure design coefficients (GCp) in standards and codes; Wood frame load path starts to be more explicitly addressed
4	1984	1991	ANSI A58.1-1982 design standard and CABO building codes; 1984 National Flood Insurance Program Flood Insurance Study adopted
5	1977	1983	Early low-rise methodology for wind loads; 1976 National Flood Insurance Program Flood Insurance Study adopted
6	1962	1976	Early hurricane wind requirements for masonry; introduction of plywood roof sheathing; Early flood requirements
7	1941	1961	No code or very simple code requirements with respect to wind and flood (During/Post-World War II growth period)
8	1866	1940	No code or very simple code requirements with respect to wind and flood (Pre-World War II)

* Beginning year of each era is generally taken as the year following the effective date of a significant building code update or national flood insurance study update to approximate the lag between permit application and completion of construction.

The architectural styles, construction practices, and building code history of Key West differ significantly from those of the rest of Monroe County. Although there are other incorporated municipalities within the county (Marathon, Key Colony Beach, Layton, and Islamorada), Key West, with approximately 1/3 of the total county population, is by far the largest and oldest. Therefore, the second stratification variable selected for the survey was location: Key West or Not Key West (KW or NKW).

The final stratification variable selected was building value as provided by the BLDG field in the MCPA_History_2013 table in the MCPA database. Building value may be correlated with building practices, roof shape, number of stories, exterior finishes (e.g., roof and wall covering

materials), and mitigation (e.g., opening protection). To capture these trends, the 75th percentile of building value was determined from the MCPA data for each Location (KW, NKW) and each Year Built Era (1-8). For each of these 16 strata, the residential building population was then further segmented or stratified into the top quartile (TopQ) and the lower three quartiles (Lr3Q) to produce a total of 32 strata.

The counts of Monroe County single family parcels in each stratum are provided in Table 2.

Table 2. Distribution of Monroe County Single Family Parcels by Stratification Variables

Year Built Era	Key West		Not Key West		Total
	Lower 3 Quartiles	Top Quartile	Lower 3 Quartiles	Top Quartile	
2008-2013	53	18	640	213	924
2003-2007	178	59	1,340	446	2,023
1993-2002	635	211	2,401	800	4,047
1984-1992	274	91	4,257	1,419	6,041
1977-1983	82	27	2,261	753	3,123
1962-1976	618	206	3,449	1,150	5,423
1941-1961	1,132	377	1,601	533	3,643
1866-1940	1,053	351	71	24	1,499
Total	**4,025**	**1,340**	**16,020**	**5,338**	**26,723**

2.4 Sampling Plan

The final component of the survey design is the sampling plan. After the survey form was designed and pilot tested on a small number of houses, it was determined that the project budget would accommodate approximately 700 inspections throughout county. Thus, the next key question to be addressed was how to best allocate the 700 inspections among the 32 strata.

The methodology for determining the optimum number of inspections within each stratum is defined in Appendix B. The algorithm requires two key inputs: (1) the proportions of the population in each stratum, and (2) the variances in expected wind loss within each stratum.

Given Table 2, the proportions are straightforward. For example, we see that 1,053 parcels, or 3.94% of the population, belong to the stratum defined by for the Lower 3 Quartiles of building value in Era 8 (1866-1940) for Key West.

To estimate the within-stratum variances, *S(h)*, we combine the Citizens Property Insurance Corporation (CPIC) exposure data for Monroe County and the wind loss relativities from studies completed by ARA for the State of Florida (Twisdale et al. 2002 and 2008). First, we use the CPIC data to estimate the fractions of Monroe County houses in each stratum with specified combinations of wind mitigation characteristics:

$x_{ij|h}$ = Fraction of CPIC personal residential policies in Monroe County as of 9/30/2013 with known wind mitigation characteristics reported to have a specific set of wind mitigation characteristics:

- Variable "i" (e.g., Roof-to-Wall Connection) with
- Response "j" (e.g., Toe-Nailed) given a house in
- Stratum "h" (e.g., Era=1984-1992, Location=Key West, Value=Top Quartile)

The variables (i) and responses (j) considered are summarized below in Table 3:

Table 3. Variables and Responses Used to Estimate Within-Stratum Standard Deviations

i	Variables (and Responses)*	Levels (ARA 2002)	Levels (ARA 2008)
1	Number of Stories (1, 2+)	1	2
2	Roof Shape (Hip, Non-Hip)	2	2
3	Roof Cover Strength (FBC Equiv., Non-FBC)	2	2
4	Roof Deck Attachment (A, B, or C)	3	3
5	Roof-Wall Connection (Toe-Nail, Clips, Wraps, Double Wraps)	4	3
6	Opening Protection (None, Basic, Hurricane)	3	2
	Total (K)	144	144

* Underlined levels denote options that were not separately evaluated in either the 2002 study (two or more stories) or the 2008 study (double wraps and basic opening protection). Four factors evaluated in the 2002 and/or 2008 studies have been omitted from this analysis: Secondary Water Resistance, Soffit Type, Roof Slope, and Roof Cover Type. These factors have been fixed at the following levels: SWR=None, Soffit Type=Wood, Roof Slope=4:12, and Roof Cover Type=Non-Tile.

If we define a new index, k, which covers all possible combination of i and j (i.e., k=1,...,144), then the expected Average Annual Loss (due to wind only) is:

$$AAL = AAL_0 \sum_{h=1}^{H} \sum_{k=1}^{K} W_h R(x_k) x_{k|h} \qquad (1)$$

where

AAL_0 = Average annual loss for house with a relativity of 1.00 or, equivalently, a credit of 0.00.

W_h = N_h/N where N is the total population size and N_h is the population size in each stratum (determined from the MPCA tax assessor database, see Table 2)

$R(x_k)$ = Florida OIR-03-001M Existing Construction Loss Relativity (ECLR) based on the ARA 2002 study (Twisdale et al. 2002) or the 2008 ARA ECLR (Twisdale 2008) for the k^{th} specific combination of wind mitigation factors and levels. When relativities are normalized to the weakest house, $R(x_{ij}) = 1 - Credit(x_{ij})$.

$$\sum_{k=1}^{K} x_{k|h} = 1.0 \quad \text{for } h=1,\ldots,H$$

Assuming that the distributions of the K factors are independent within each stratum, the variance of the AAL due to the variability within the stratum of the K factors is:

$$Var(AAL) \cong AAL_0^2 \sum_{h=1}^{H} W_h^2 \left(\frac{1}{n_h} - \frac{1}{N_h}\right)\left(\sum_{k=1}^{K} R^2(x_k) Var(x_{k|h})\right) \tag{2}$$

where

$$Var(x_{k|h}) \cong x_{k|h}(1 - x_{k|h}) \tag{3}$$

and the normalized within-stratum standard deviation is:

$$S(h) = \sqrt{\left(\sum_{k=1}^{K} R^2(x_k) Var(x_{k|h})\right)} \tag{4}$$

Using the estimates of within-stratum standard deviation given in Equation (4), the population proportions derived from Table 2, and the optimal allocation formula given in Appendix B, the final sampling rates for a 700 inspection survey are provided below in Table 4. After rounding the number of inspections allocated to each stratum to the nearest whole number, the total number of planned inspections, shown at the bottom of the "Plan" column in Table 4, is 704.

As an example of the effect of within-stratum variability on the number of inspections allocated, consider Stratum 4 (Era: 1984-1992, Location: Key West, Value: Lower 3 Quartiles). Based on the distribution of CPIC wind mitigation characteristics and Equation (4), Stratum 4 has the largest normalized within-stratum standard deviation: $S(h)$=1.570. This stratum contains 1.03% of the total population, but it was assigned 1.53% of the available inspections due to its relatively high variability in CPIC wind mitigation features. In contrast, Stratum 30 (Era: 1962-1976, Location: Not Key West, Value: Top Quartile) is at the low end of the within-stratum variability spectrum, with $S(h)$=0.801. Stratum 30 contains 4.30% of the total population, but it was assigned just 3.28% of the available inspections due to its relatively low variability in CPIC wind mitigation features.

After assigning each single family parcel in the county to its proper stratum, the parcels within each stratum (h) were randomly assigned a whole number between 1 and N_h. The inspections were performed in order of the randomly assigned numbers until the planned number of inspections was reached. Houses were skipped if the homeowner could not be contacted or chose not to participate in the project. As expected, the actual numbers of inspections that were ultimately performed in each stratum differed slightly from the planned numbers. The actual numbers of inspections performed are shown in the "Actual" column of Table 4, and the differences between planned and actual are shown in the "Diff" column.

Table 4. Stratified Sampling Plan

Stratum	Era	Location	Value	Nh	Nh/N	Sh	NhSh	nh/n	(nh/n)/ (Nh/N)	Plan	Actual	Diff
1	2008-2013	KW	Lr3Q	53	0.20%	1.068	56.6	0.20%	1.018	1	1	-
2	2003-2007	KW	Lr3Q	178	0.67%	1.085	193.1	0.69%	1.033	5	5	-
3	1993-2002	KW	Lr3Q	635	2.38%	1.430	908.1	3.23%	1.361	23	23	-
4	1984-1992	KW	Lr3Q	274	1.03%	1.570	430.2	1.53%	1.494	11	11	-
5	1977-1983	KW	Lr3Q	82	0.31%	1.324	108.6	0.39%	1.261	3	3	-
6	1962-1976	KW	Lr3Q	618	2.31%	0.943	582.8	2.08%	0.897	15	15	-
7	1941-1961	KW	Lr3Q	1,132	4.24%	1.039	1,176.2	4.19%	0.989	29	31	2
8	1866-1940	KW	Lr3Q	1,053	3.94%	1.384	1,457.4	5.19%	1.317	36	35	(1)
9	2008-2013	NKW	Lr3Q	640	2.39%	1.058	677.1	2.41%	1.007	17	17	-
10	2003-2007	NKW	Lr3Q	1,340	5.01%	1.046	1,401.6	4.99%	0.995	35	34	(1)
11	1993-2002	NKW	Lr3Q	2,401	8.98%	1.035	2,485.0	8.85%	0.985	62	63	1
12	1984-1992	NKW	Lr3Q	4,257	15.93%	1.168	4,972.2	17.70%	1.111	124	124	-
13	1977-1983	NKW	Lr3Q	2,261	8.46%	1.072	2,423.8	8.63%	1.020	60	60	-
14	1962-1976	NKW	Lr3Q	3,449	12.91%	0.996	3,435.2	12.23%	0.948	86	85	(1)
15	1941-1961	NKW	Lr3Q	1,601	5.99%	0.955	1,529.0	5.44%	0.909	38	37	(1)
16	1866-1940	NKW	Lr3Q	71	0.27%	1.047	74.3	0.27%	0.997	2	2	-
17	2008-2013	KW	TopQ	18	0.07%	1.068	19.2	0.07%	1.010	1	1	-
18	2003-2007	KW	TopQ	59	0.22%	1.088	64.2	0.23%	1.037	2	2	-
19	1993-2002	KW	TopQ	211	0.79%	0.991	209.1	0.74%	0.942	5	5	-
20	1984-1992	KW	TopQ	91	0.34%	1.223	111.3	0.40%	1.163	3	3	-
21	1977-1983	KW	TopQ	27	0.10%	1.099	29.7	0.11%	1.049	1	1	-
22	1962-1976	KW	TopQ	206	0.77%	0.894	184.2	0.66%	0.851	5	5	-
23	1941-1961	KW	TopQ	377	1.41%	0.954	359.7	1.28%	0.908	9	9	-
24	1866-1940	KW	TopQ	351	1.31%	1.365	479.1	1.71%	1.299	12	12	-
25	2008-2013	NKW	TopQ	213	0.80%	1.064	226.6	0.81%	1.012	6	5	(1)
26	2003-2007	NKW	TopQ	446	1.67%	1.062	473.7	1.69%	1.010	12	14	2
27	1993-2002	NKW	TopQ	800	2.99%	0.780	624.0	2.22%	0.742	16	15	(1)
28	1984-1992	NKW	TopQ	1,419	5.31%	0.908	1,288.5	4.59%	0.864	32	29	(3)
29	1977-1983	NKW	TopQ	753	2.82%	0.957	720.6	2.57%	0.911	18	17	(1)
30	1962-1976	NKW	TopQ	1,150	4.30%	0.801	921.2	3.28%	0.762	23	23	-
31	1941-1961	NKW	TopQ	533	1.99%	0.823	438.7	1.56%	0.783	11	11	-
32	1866-1940	NKW	TopQ	24	0.09%	1.099	26.4	0.09%	1.047	1	1	-
Totals				**26,723**	**100.0%**		**28,087**	**100.0%**	**1.000**	**704**	**699**	**(5)**

N = Total population of single family homes with known year built and known building tax value = 26,723

Nh = Total population in stratum h

n = Total planned sample size = 704

nh = Planned sample size in stratum h (= "Plan" after rounding to the nearest whole number)

Sh = Estimated standard deviation of the wind average annual loss (AAL) for houses in stratum h normalized by the AAL of a 1 story, gable house with non-FBC roof cover, roof deck B, roof-wall clips, no opening protection, no SWR, wood soffits, 4:12 roof slope and non-tile roof covering

KW = Key West; NKW = Not Key West (i.e., all of Monroe County except Key West)

Lr3Q = Lower three quartiles of building value (i.e., houses with assessed building values up to the 75th percentile for a given Era and Location)

TopQ = Top quartile of building value (i.e., houses with assessed building values above the 75th percentile for a given Era and Location)

3. Survey Results

In this section, we present the overall survey results with confidence intervals for each variable in Section 3.1. Trends of key variables by construction era are presented in Section 3.2, and examples of trends by location and building value are presented in Section 3.3.

3.1 Overall Results

The results for the individual survey items, when projected to the entire population, are provided in Table 5. The column labeled **n** provides the total number of surveys for which responses were recorded for the survey **Item** and **Description** provided on that row. For the categorical variables, the column labeled $\mathbf{n_i}$ provides the number of surveys that produced the **Response** described on that row. For the smaller set of numeric variables (e.g., year built, floor area, or roof slope), the column labeled $\mathbf{n_i}$ is left blank.

For each categorical variable, the population estimates of the proportion of the Monroe County single family residential building belonging to each **Response** is provided in the column labeled $\widehat{\boldsymbol{p}}$. For the numeric variables, the value provided in the column labeled $\widehat{\boldsymbol{p}}$ is the estimate of the population mean rather than a proportion. Due to differences in sampling rates within each stratum, the population estimates are not simply n_i/n. Instead, the population estimates are the within-stratum frequencies weighted by their respective sampling rates.

For the categorical variables, the 95% confidence interval for each population proportion estimate has been computed using the methodology described in Appendix C. The lower and upper bounds of the 95% confidence interval are provided in the columns labeled **LB95** and **UB95**, respectively.

For the numeric variables, the population estimates are the within-stratum means weighted by their respective sampling rates. For $n \geq 30$, the 95% bounds on the numeric variables are given by:

$$LB = \hat{p} - 1.96\hat{s}/\sqrt{n} \tag{5}$$

$$UB = \hat{p} + 1.96\hat{s}/\sqrt{n} \tag{6}$$

where $\hat{s}$ is the weighted population standard deviation. For $n < 30$, the 1.96 in Equations (5) and (6) is replaced by a larger corresponding value from Student's t-distribution. Histograms of the numeric variables are presented in Figure 1 through Figure 14.

Table 5. Population Frequency Estimates (p^) with 95% Confidence Lower Bounds (LB95) and Upper Bounds (UB95)

Form	Item	Description	Response	n	n_i	LB95	p^	UB95
Both	F1	Year built	Numeric	697		1977	1979	1980
Both	F2	Occupancy	One-Family	699	671	0.946	0.962	0.978
			Two-Family		15	0.008	0.020	0.032
			Other		13	0.006	0.018	0.029
Both	F3	Configuration	Detached	696	660	0.943	0.958	0.973
			Townhouse		36	0.027	0.042	0.057
Both	F4	Construction	Unknown	699	10	0.003	0.016	0.028
			Wood Frame		330	0.390	0.441	0.491
			Unreinforced Masonry		6	0.000	0.010	0.020
			Reinforced Masonry		317	0.431	0.481	0.531
			Reinforced Concrete		32	0.025	0.047	0.068
			Steel Frame		2	0.000	0.003	0.009
			Light Metal Frame		2	0.000	0.003	0.008
Both	F5	Stories	Numeric	634		1.70	1.75	1.80
Both	F6	Floor Area (Sq. Ft)	Numeric	698		1515	1569	1624
Both	F7	Building condition	Poor	699	3	0.000	0.004	0.010
			Average		250	0.311	0.351	0.392
			Good		446	0.604	0.644	0.685
Both	G1	Building code	A - FBC	696	99	0.110	0.141	0.173
			B - HVHZ		3	0.000	0.004	0.010
			C - N/A		594	0.825	0.855	0.885
Both	G1a	Bldg. Code Year	Numeric	698		1977	1979	1980
Both	G2	Roof covering	Asphalt/fiberglass shingle	694	153	0.175	0.220	0.265
			Concrete/clay tiles		47	0.046	0.075	0.103
			Metal: V-crimp	694	353	0.444	0.499	0.554
			Metal: corrugated		5	0.000	0.008	0.017
			Metal: standing seam		23	0.014	0.034	0.054
			Metal shingle		17	0.005	0.021	0.037

Form	Item	Description	Response	n	n_i	LB95	$\hat{p}$	UB95
Both	G2	Roof covering (continued)	Metal tile		1	0.000	0.001	0.005
			Wood shakes		1	0.000	0.001	0.005
			Built-up roof with gravel		6	0.000	0.009	0.020
			Built-up roof w/o gravel		12	0.004	0.019	0.034
			Single ply membrane ballasted		5	0.000	0.006	0.015
			Single ply membrane		33	0.025	0.048	0.072
			Painted/sealed concrete		38	0.033	0.058	0.084
2	G2a	ASTM D-3161 F	Yes	594	0	0.000	0.000	0.005
			No (or unknown)		594	0.995	1.000	1.000
2	G2b	ASTM D-7159 G	Yes	594	3	0.000	0.005	0.011
			No (or unknown)		591	0.989	0.995	1.000
2	G2c	ASTM D-7159 H	Yes	594	1	0.000	0.002	0.005
			No (or unknown)		593	0.995	0.998	1.000
Both	G3	Roof deck attachment	0 Unknown	698	27	0.016	0.037	0.057
			1 Batten decking / Skipped sheathing		10	0.000	0.012	0.023
			2 Plywood/OSB w/ unknown connection strength		1	0.000	0.001	0.006
			3 Plywood/OSB w/ adhesive/epoxy		3	0.000	0.005	0.013
			4 Plywood/OSB w/ 6d nails or staples		10	0.001	0.013	0.026
			5 Plywood/OSB w/ 8d Nails @ 6/12 or better		353	0.449	0.504	0.559
			6 Plywood/OSB w/ 8d Nails @ 6/6 or better		98	0.102	0.140	0.178
			7 Plywood/OSB w/ 8d Ring Shank Nails @ 6/6 or better		7	0.000	0.011	0.022
			8 Plywood/OSB w/ 10d Nails @ 6/6 or better		6	0.000	0.009	0.019
			9 Dimensional lumber / Tongue & groove decking with less than 2 nails per board		61	0.056	0.087	0.118
			10 Dimensional lumber / Tongue & groove decking with at least 2 nails per board		72	0.073	0.107	0.140
			11 Normal weight reinforced concrete roof deck (with or without metal decking)		47	0.043	0.071	0.099
			12 Lightweight or gypsum concrete on plywood or metal decking		1	0.000	0.001	0.005
			13 Metal deck with insulation		2	0.000	0.003	0.009

Form	Item	Description	Response	n	n_i	LB95	$p^{\wedge}$	UB95
Both	G4	Roof to wall attachment	0 Unknown	697	46	0.038	0.062	0.087
			1 Toe nailing or screws		40	0.031	0.053	0.076
			2 Clips		323	0.413	0.463	0.513
			3 Single wraps		184	0.225	0.270	0.314
			4 Double wraps		36	0.030	0.052	0.074
			5 Structural (bolted, welded, à)		32	0.024	0.045	0.065
			6 Integrated RC slab with masonry wall		36	0.033	0.055	0.078
Both	G5	Roof Geometry	1 Hip (at least 90% of perimeter)	697	206	0.259	0.307	0.355
			2 Flat		50	0.049	0.077	0.104
			3 Gable		420	0.537	0.588	0.639
			4 Shed (mono slope)		4	0.000	0.006	0.014
			5 Mansard		9	0.000	0.011	0.022
			7 Gambrel		1	0.000	0.002	0.006
			9 Dutch hip that does not meet requirements for hip		2	0.000	0.002	0.007
			10 Complex (multiple types exist and does not meet requirements for hip)		3	0.000	0.004	0.011
			11 Other		2	0.000	0.002	0.008
Both	G6	SWR	A SWR	699	113	0.132	0.163	0.195
			B No SWR		137	0.164	0.197	0.231
			C Unknown or Undetermined		449	0.598	0.639	0.680
Both	G7	Opening Protection	Unknown	645	15	0.007	0.024	0.041
			A		382	0.548	0.600	0.652
			B		34	0.030	0.055	0.080
			C		11	0.004	0.018	0.032
			N - Unverified A or B		142	0.172	0.217	0.262
			N - Other - Not A, B, or C		22	0.012	0.031	0.049
			X		31	0.022	0.044	0.065
			N/A		8	0.000	0.012	0.024

Form	Item	Description	Response	n	n_i	LB95	p^	UB95
1	G7x	Opening Protection	All protection is permanently in place (e.g., all openings are impact rated units and do not require shuttering)	102	21	0.105	0.210	0.315
			Temporary Shutters (e.g., panels, roll-down, etc. -- this is generally the most common case)		52	0.396	0.525	0.654
			Some or all of the protection includes impact-resistant fabric screens		16	0.054	0.145	0.237
			Not to Code		1	0.000	0.008	0.030
			None		11	0.025	0.104	0.183
			N/A		1	0.000	0.007	0.029
Both	H1	Level of engineering	0 Unknown	699	581	0.791	0.825	0.860
			1 Minimally engineered or non-engineered		9	0.003	0.014	0.025
			2 Partially engineered structure ("deemed to comply")		67	0.070	0.098	0.127
			3 Fully engineered structure		42	0.039	0.062	0.085
Both	H2	Braced gables?	No	698	203	0.236	0.277	0.317
			Yes (some)		4	0.000	0.006	0.012
			Yes (all)		213	0.264	0.305	0.347
			N/A		278	0.368	0.412	0.457
Both	H3	Roof slope (x/12)	Numeric	692		4.1	4.2	4.4
Both	H3a	Roof slope (deg.)	Numeric	695		16.4	17.0	17.6
Both	H4	Roof cover attachment	0=Unknown	682	49	0.046	0.072	0.099
			1=Staples		7	0.000	0.010	0.020
			2=Nails		218	0.265	0.314	0.363
			3=Screws		**358**	**0.470**	**0.523**	**0.576**
			5=Adhesive		30	0.024	0.047	0.069
			6=Mortar (tiles)		18	0.013	0.031	0.049
			Rebar		1	0.000	0.002	0.006
			N/A		1	0.000	0.002	0.006
Both	H5	Roof cover age (years)	Numeric	627		13.5	14.3	15.0

Form	Item	Description	Response	n	n_i	LB95	$\hat{p}$	UB95
Both	H6	Roof cover condition	Poor	698	2	0.000	0.002	0.007
			Fair		15	0.008	0.021	0.035
			Average		230	0.282	0.327	0.371
			Good		375	0.494	0.541	0.588
			New		76	0.079	0.109	0.138
Both	H7	Roof vents	unknown	699	1	0.000	0.002	0.005
			Yes		147	0.179	0.214	0.248
			No		551	0.750	0.785	0.819
Both	H8	Parapets	Yes	698	8	0.002	0.009	0.016
			No		690	0.984	0.991	0.998
Both	H9	Dormers	Yes	699	29	0.025	0.039	0.054
			No		670	0.946	0.961	0.975
Both	H10	Soffit material	Wood	699	318	0.406	0.451	0.496
			Vinyl		190	0.228	0.268	0.308
			Other		180	0.226	0.266	0.306
			No		11	0.004	0.016	0.027
Both	H11	Eave height (feet)	Numeric	691		16.0	16.5	17.0
Both	H12	Overhang/Rake	None	696	7	0.001	0.010	0.019
			Small (< 8 in)		22	0.013	0.030	0.047
			8-12 inches		153	0.171	0.211	0.251
			13-36 inches		460	0.622	0.668	0.714
			Large (> 36 in)		54	0.054	0.081	0.108
Both	H13	Flashing/coping	Unknown	699	40	0.033	0.055	0.077
			No		2	0.000	0.003	0.008
			Poor Cond.		1	0.000	0.001	0.005
			Avg. Cond.		190	0.224	0.268	0.312
			Good Cond.		349	0.449	0.499	0.549
			Good Cond. & ES1 compliant		117	0.136	0.173	0.211

Form	Item	Description	Response	n	n_i	LB95	$\hat{p}$	UB95
Both	H14	Rooftop equipment	Unknown	699	2	0.000	0.003	0.008
			No		667	0.934	0.952	0.970
			Yes		30	0.025	0.045	0.064
Both	H15	Rooftop equip. anchorage	Unknown	48	22	0.270	0.431	0.591
			Adequate/Engineered		25	0.393	0.554	0.715
			N/A		1	0.000	0.015	0.055
Both	H16	Exterior wall construction	Unknown	697	2	0.000	0.003	0.009
			Masonry		343	0.475	0.522	0.570
			Brick veneer		1	0.000	0.002	0.006
			Frame		332	0.393	0.444	0.495
			Reinforced concrete (panels or cast-in-place)		2	0.000	0.003	0.009
			Other		17	0.008	0.026	0.044
Both	H17	Exterior wall covering material	0 Unknown	698	3	0.000	0.004	0.011
			2 Metal sheathing		2	0.000	0.003	0.009
			3 Wood siding (clapboards)		85	0.073	0.105	0.138
			4 Wood panels (e.g., T-111 siding)		76	0.072	0.105	0.137
			6 Aluminum siding		2	0.000	0.003	0.009
			7 Vinyl siding		76	0.073	0.106	0.139
			8 Hardboard		31	0.019	0.040	0.061
			10 Stucco		369	0.506	0.559	0.611
			11 Cement board (e.g., Hardie plank)		52	0.044	0.072	0.099
			12 Reinforced concrete (panels or cast-in-place)		1	0.000	0.001	0.005
			13 Asbestos siding		1	0.000	0.001	0.005
Both	H18	Exterior wall covering condition	Unknown	699	1	0.000	0.001	0.005
			Fair		10	0.003	0.014	0.025
			Average		137	0.153	0.190	0.227
			Good		528	0.724	0.764	0.804
			New		23	0.015	0.031	0.048
Both	H19	Glass % of wall area	Numeric	695		18.0	18.5	18.9

Form	Item	Description	Response	n	n_i	LB95	p^	UB95
Both	H20a	Window glass type Annealed	Yes	699	525	0.711	0.744	0.776
			No		174	0.224	0.256	0.289
Both	H20b	Window glass type Tempered	Yes	699	32	0.031	0.047	0.062
			No		667	0.938	0.953	0.969
Both	H20c	Window glass type Heat Str.	Yes	699	1	0.000	0.001	0.004
			No		698	0.996	0.999	1.000
Both	H20d	Window glass type Laminated	Yes	699	226	0.296	0.331	0.366
			No		473	0.634	0.669	0.704
Both	H20e	Window glass type Plastic/Acrylic	Yes	699	2	0.000	0.002	0.006
			No		697	0.994	0.998	1.000
Both	H20f	Window glass type Unknown	Yes	699	7	0.002	0.010	0.017
			No		692	0.983	0.990	0.998
Both	H21a	Window glass const. Sgl. Pane	Yes	699	600	0.828	0.854	0.880
			No		99	0.120	0.146	0.172
Both	H21b	Window glass const. Insulated	Yes	699	115	0.143	0.171	0.199
			No		584	0.801	0.829	0.857
Both	H21c	Window glass const. Unknown	Yes	699	8	0.003	0.011	0.019
			No		691	0.981	0.989	0.997
Both	H22a	Door glass type Annealed	Yes	699	99	0.117	0.143	0.169
			No		600	0.831	0.857	0.883
Both	H22b	Door glass type Tempered	Yes	699	466	0.628	0.663	0.698
			No		233	0.302	0.337	0.372
Both	H22c	Door glass type Heat Str.	Yes	699	0	0.000	0.000	0.004
			No		699	0.996	1.000	1.000
Both	H22d	Door glass type Laminated	Yes	699	193	0.251	0.284	0.318
			No		506	0.682	0.716	0.749
Both	H22e	Door glass type Plastic/Acrylic	Yes	699	0	0.000	0.000	0.004
			No		699	0.996	1.000	1.000
Both	H22f	Door glass type Unknown	Yes	699	9	0.004	0.011	0.019
			No		690	0.981	0.989	0.996

Form	Item	Description	Response	n	n_i	LB95	$\hat{p}$	UB95
Both	H22g	Door glass type None	Yes	699	14	0.009	0.019	0.029
			No		685	0.971	0.981	0.991
Both	H23a	Door glass const. Sgl. Pane	Yes	699	579	0.796	0.824	0.852
			No		120	0.148	0.176	0.204
Both	H23b	Door glass const. Insulated	Yes	699	96	0.116	0.142	0.168
			No		603	0.832	0.858	0.884
Both	H23c	Door glass const. Unknown	Yes	699	4	0.000	0.005	0.011
			No		695	0.989	0.995	1.000
Both	H23d	Door glass const. N/A	Yes	699	21	0.017	0.030	0.042
			No		678	0.958	0.970	0.983
Both	H24a	Door config. French	Yes	699	103	0.113	0.138	0.164
			No		596	0.836	0.862	0.887
Both	H24b	Door config. Double	Yes	699	264	0.337	0.373	0.408
			No		435	0.592	0.627	0.663
Both	H24c	Door config. Sliders	Yes	699	371	0.504	0.541	0.578
			No		328	0.422	0.459	0.496
Both	H24d	Door config. Single	Yes	699	629	0.881	0.903	0.925
			No		70	0.075	0.097	0.119
Both	H25a	Door const. Hollow	Yes	699	9	0.005	0.013	0.022
			No		690	0.978	0.987	0.995
Both	H25b	Door const. Solid	Yes	699	661	0.929	0.946	0.963
			No		38	0.037	0.054	0.071
Both	H25c	Door const. Reinforced	Yes	699	14	0.010	0.021	0.032
			No		685	0.968	0.979	0.990
Both	H25d	Door const. Unknown	Yes	699	12	0.007	0.017	0.027
			No		687	0.973	0.983	0.993
Both	H26	Garage configuration	None	692	556	0.754	0.789	0.824
			Detached		9	0.005	0.015	0.026
			Attached		127	0.162	0.196	0.230

Form	Item	Description	Response	n	n_i	LB95	p^	UB95
Both	H27a	Garage doors Single	Yes	699	98	0.123	0.149	0.176
			No		601	0.824	0.851	0.877
Both	H27b	Garage doors Double-16'	Yes	699	46	0.053	0.072	0.092
			No		653	0.908	0.928	0.947
Both	H27c	Garage doors Double-18'	Yes	699	1	0.000	0.002	0.005
			No		698	0.995	0.998	1.000
Both	H28	Carports	No	693	600	0.832	0.861	0.891
			Detached		25	0.021	0.037	0.053
			Attached		68	0.076	0.102	0.127
Both	H29	Fences	Yes	699	462	0.622	0.658	0.693
			No		237	0.307	0.342	0.378
Both	H30	Enclosed porch	Yes	697	90	0.105	0.130	0.155
			No		607	0.845	0.870	0.895
Both	H31	Screened porch	Yes	699	233	0.305	0.340	0.375
			No		466	0.620	0.660	0.700
Both	H32	Open porch/balcony	Yes	699	480	0.642	0.677	0.712
			No		219	0.283	0.323	0.363
Both	H33	Shed	Attached	698	12	0.006	0.018	0.029
			Detached		200	0.251	0.290	0.328
			No		486	0.653	0.692	0.731
Both	H34	Pool cage (metal screened enclosure)	Yes	698	19	0.017	0.029	0.042
			No		679	0.958	0.971	0.983
Both	H35	Other exterior structures?	Yes	697	131	0.167	0.197	0.226
			No		566	0.774	0.803	0.833
Both	I1	Distance to coast > 1500 ft.	Yes	699	157	0.176	0.206	0.236
			No		542	0.764	0.794	0.824
Both	I2	Exposure category	B	699	152	0.165	0.199	0.232
			C		245	0.309	0.350	0.390
			D		302	0.410	0.452	0.494

Form	Item	Description	Response	n	n_1	LB95	$p^{\wedge}$	UB95
Both	I4	Tree fall hazard	Yes	699	594	0.819	0.846	0.873
			No		105	0.127	0.154	0.181
Both	I5	Closest adjacent house (ft.)	Numeric	693		42.2	50.2	58.2
Both	I6	Small debris hazard (roof ballast)	Yes	699	611	0.842	0.870	0.899
			No		88	0.105	0.130	0.154
Both	I7	Large debris hazard	Yes	698	654	0.922	0.939	0.957
			No		44	0.040	0.061	0.081
Both	J1	Finished floor elevation above grade (ft.)	Numeric	698		5.6	5.9	6.2
Both	J1a	Grade	Numeric	699		3.3	3.5	3.7
Both	J2	Grade datum	NAVD88	699	699	0.996	1.000	1.000
Both	J3	Grade source	Monroe County GIS	699	699	0.996	1.000	1.000
Both	J4	Foundation type	0 Unknown/default	696	2	0.000	0.003	0.008
			1 Masonry basement		1	0.000	0.002	0.005
			3 Crawlspace -- first floor supported by masonry or concrete walls		43	0.033	0.056	0.079
			5 Mat/slab		146	0.184	0.226	0.268
			6 Continuous Footing		56	0.057	0.085	0.113
			7 Post & pier		80	0.072	0.103	0.133
			8 Pile		368	0.476	0.526	0.576
Both	J5	Wall/Floor to Foundation connection	0 Unknown/default	699	21	0.011	0.029	0.046
			1 Gravity/Friction		29	0.015	0.034	0.053
			2 Nails/Screws		19	0.011	0.027	0.044
			4 Hurricane ties		285	0.340	0.390	0.441
			5 Bolted connections (other than anchor bolts embedded in concrete)		4	0.000	0.007	0.015
			6 1/2" dia. Anchor bolts @ 6ft Spacing O.C.		1	0.000	0.001	0.005
			7 1/2" dia. Anchor Bolts @ 4ft Spacing		6	0.000	0.009	0.019
			8 5/8" dia. Anchor Bolts @ 6ft Spacing O.C.		8	0.000	0.011	0.022
			9 Continuous structural connections (e.g., lapped rebar in poured-in-place concrete)		326	0.440	0.492	0.544

Form	Item	Description	Response	n	n_i	LB95	p^	UB95
Both	J6	Wet flood proofing above FFE?	Unknown	654	89	0.113	0.144	0.175
			Yes		6	0.001	0.010	0.018
			No		559	0.815	0.846	0.878
Both	J7	Bottom of lowest floor joist from Grade	Numeric	439		5.9	6.2	6.6
Both	J8	Electric service box elev. from Grade	Numeric	695		5.4	5.5	5.6
Both	J9	Electric outlet lowest elev. from Grade	Numeric	696		3.5	3.6	3.7
Both	J10	Heat pump	Yes	699	8	0.004	0.012	0.020
			No		691	0.980	0.988	0.996
Both	J11	Air Conditioning Equip.	Yes	699	692	0.983	0.990	0.998
			No		7	0.002	0.010	0.019
Both	J12	Furnace	Yes	699	6	0.000	0.008	0.015
			No		693	0.982	0.992	0.999
Both	J13	Pool	Yes	698	176	0.218	0.255	0.292
			No		522	0.710	0.745	0.780
Both	J14	Pool equipment	Yes	698	179	0.227	0.260	0.292
			No		519	0.708	0.740	0.773
Both	J15	Enclosed area below FF?	Yes/Storage	699	232	0.296	0.336	0.376
			Yes/Living		42	0.041	0.061	0.082
			No		425	0.561	0.603	0.644
Both	J16	Enclosed area has flood vents?	Yes	688	196	0.247	0.288	0.330
			No		107	0.126	0.159	0.193
			N/A		385	0.507	0.552	0.597
Both	J17	Enclosed area has breakaway walls?	Unknown	686	61	0.064	0.092	0.119
			Yes		95	0.107	0.140	0.173
			No		133	0.159	0.197	0.235
			N/A		397	0.522	0.571	0.617

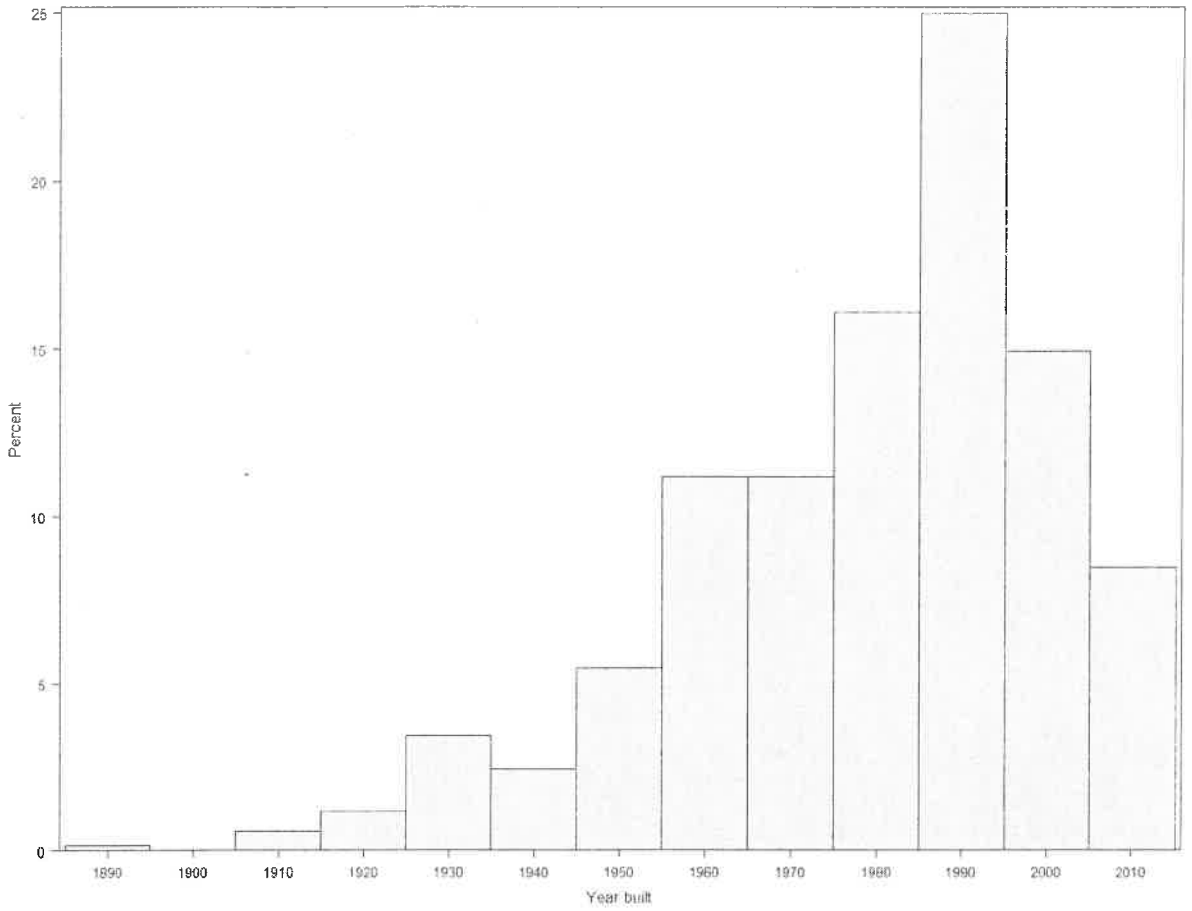

Figure 1. Distribution of Year Built (F1)

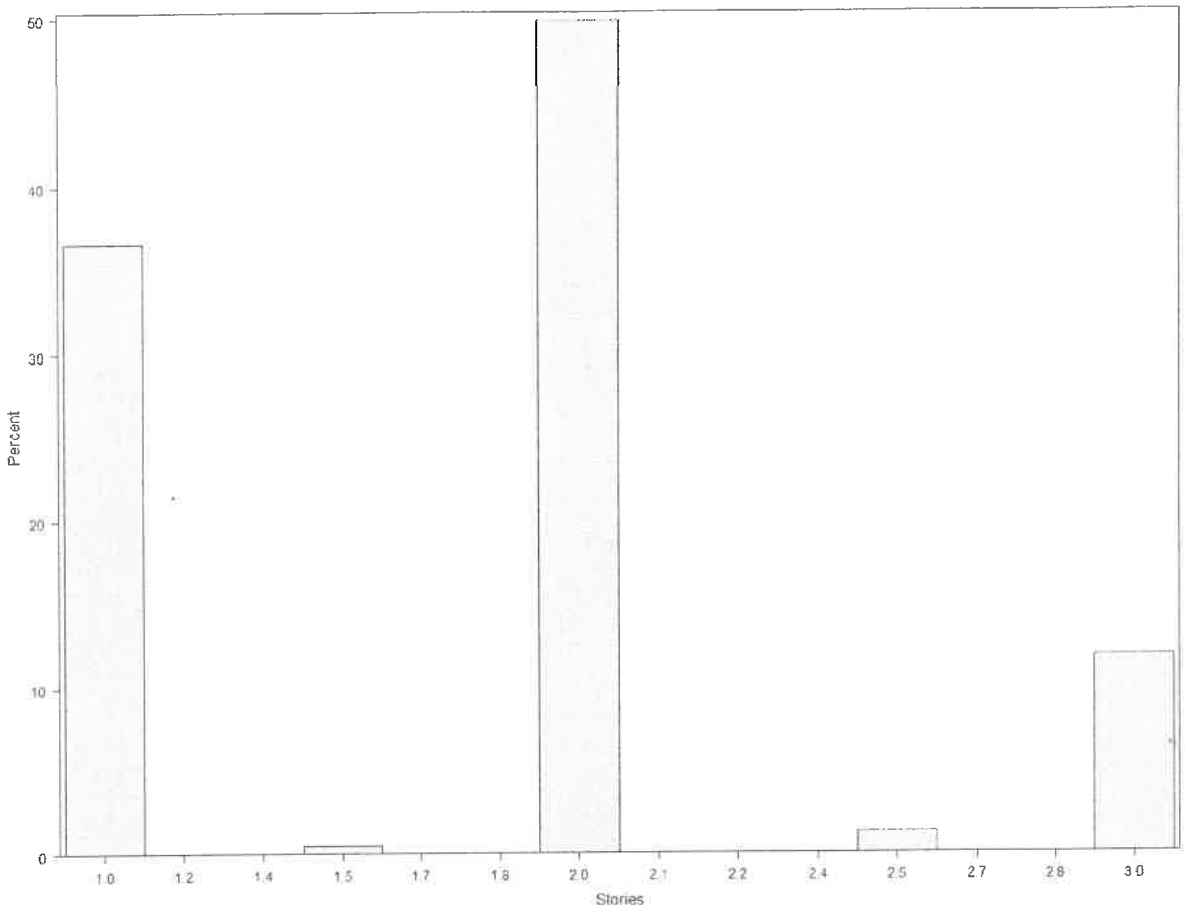

Figure 2. Distribution of Number of Stories (F5)

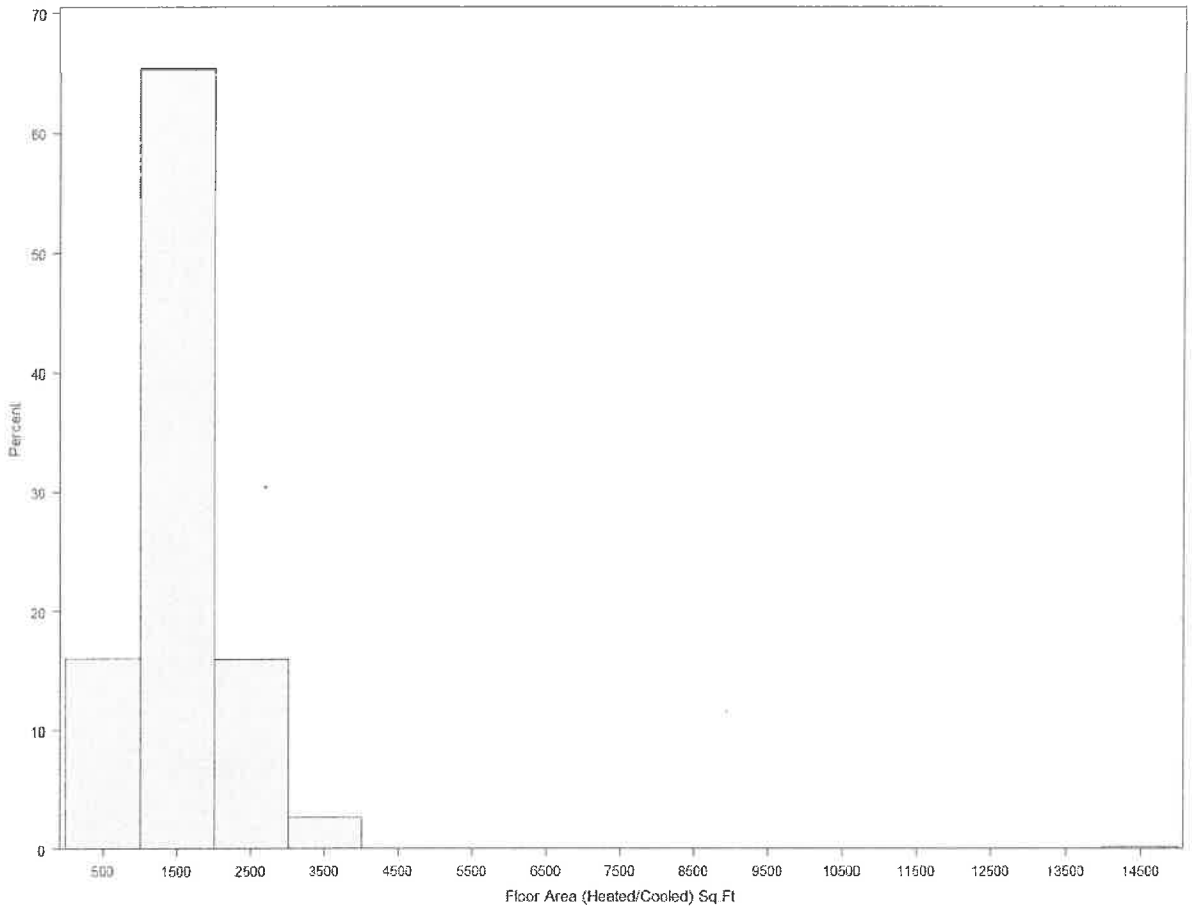

Figure 3. Distribution of Floor Area (F6)

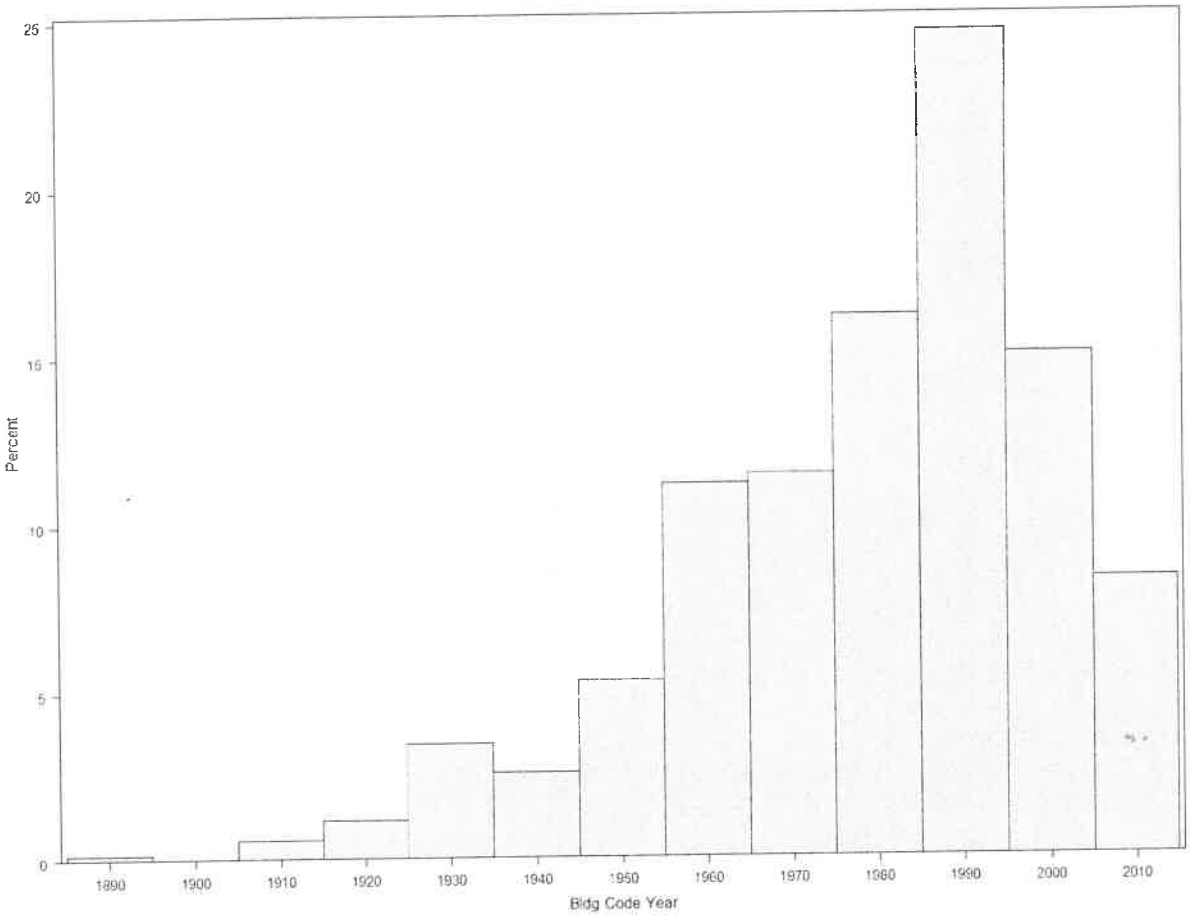

Figure 4. Distribution of Building Code Year (G1)

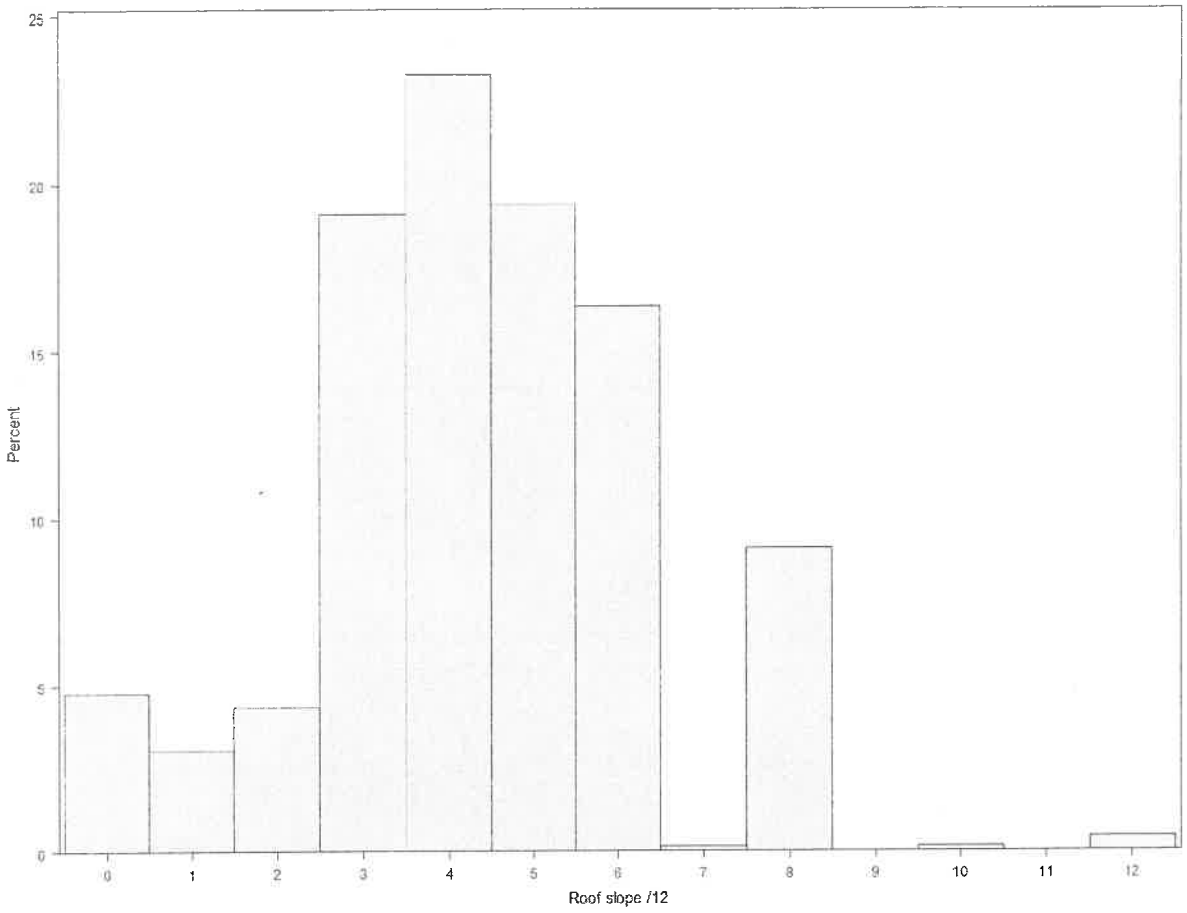

Figure 5. Distribution of Roof Slope (H3)

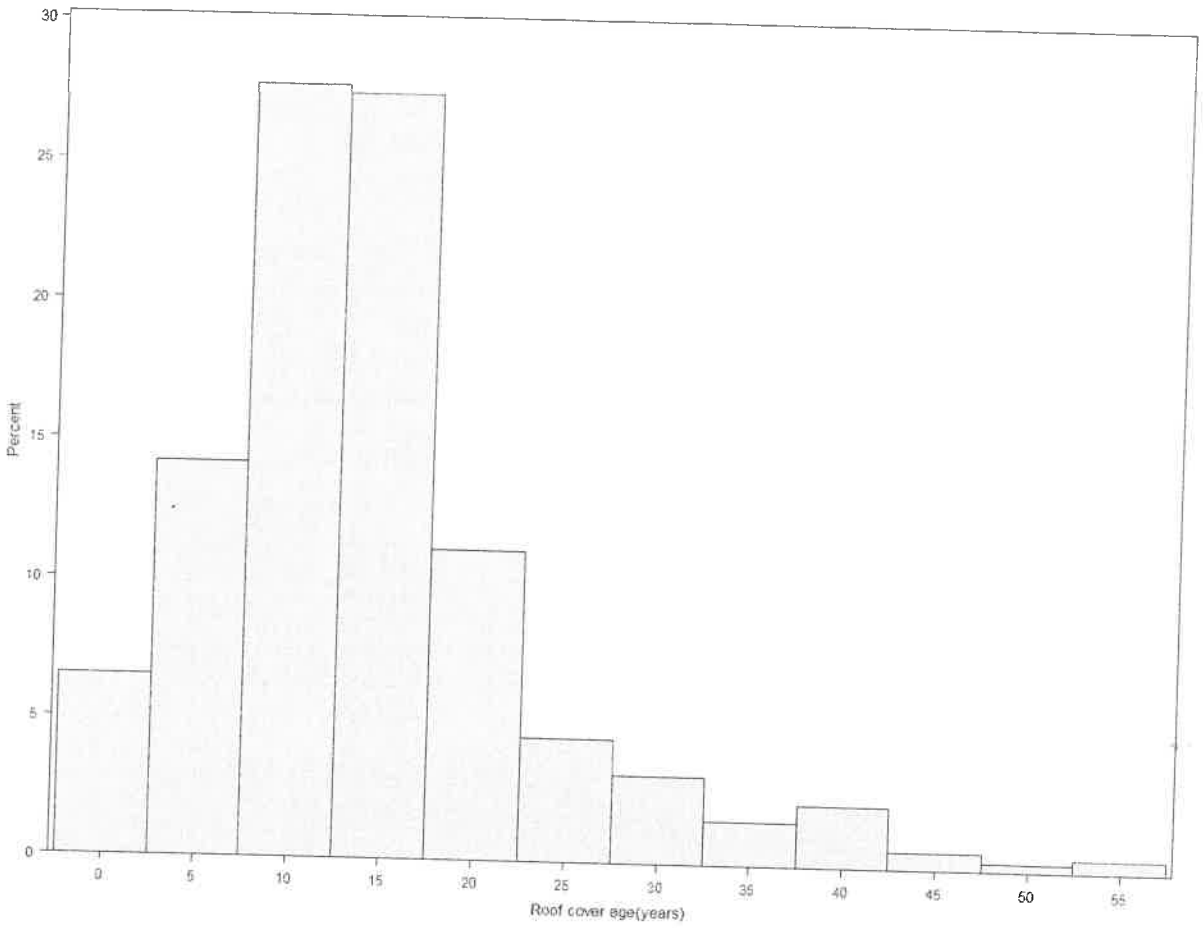

Figure 6. Distribution of Roof Cover Age (H5)

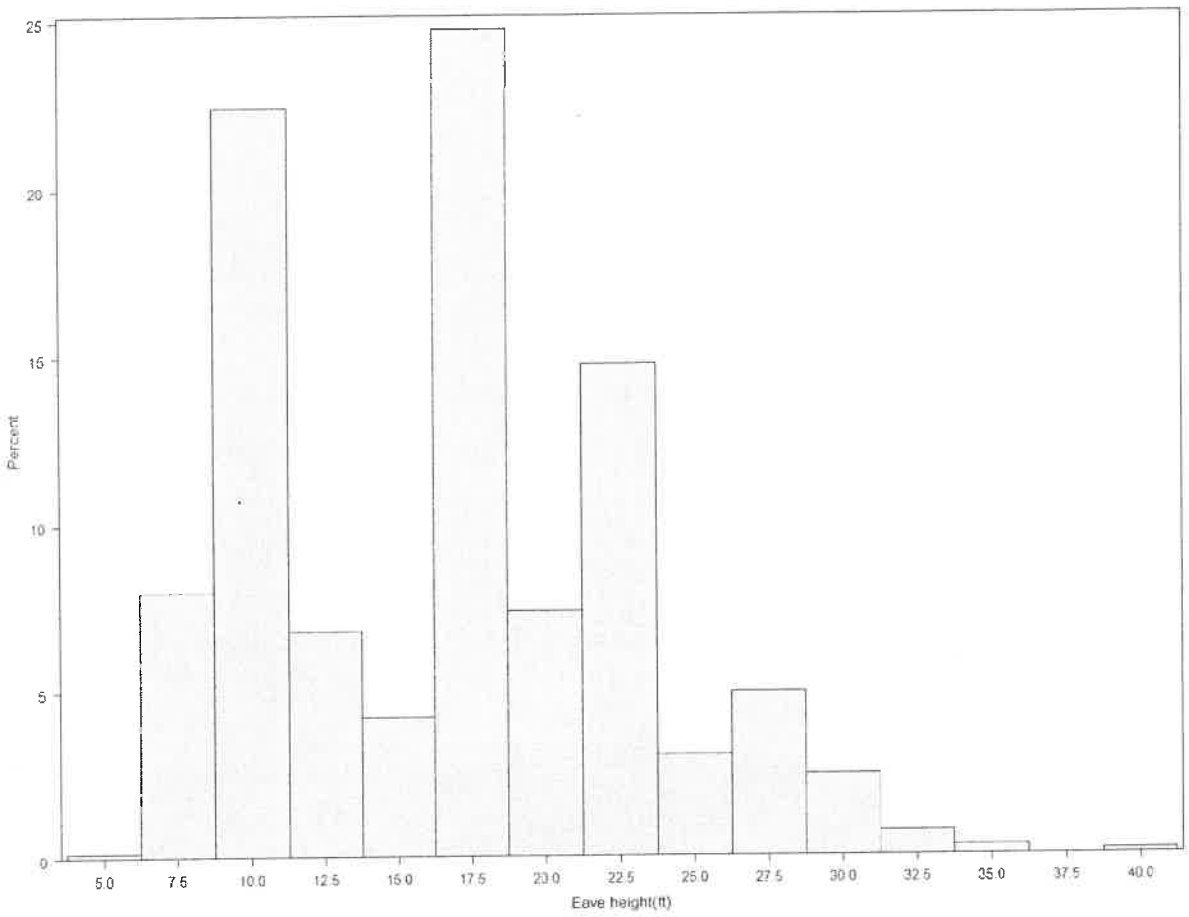

Figure 7. Distribution of Eave Height above Grade (H11)

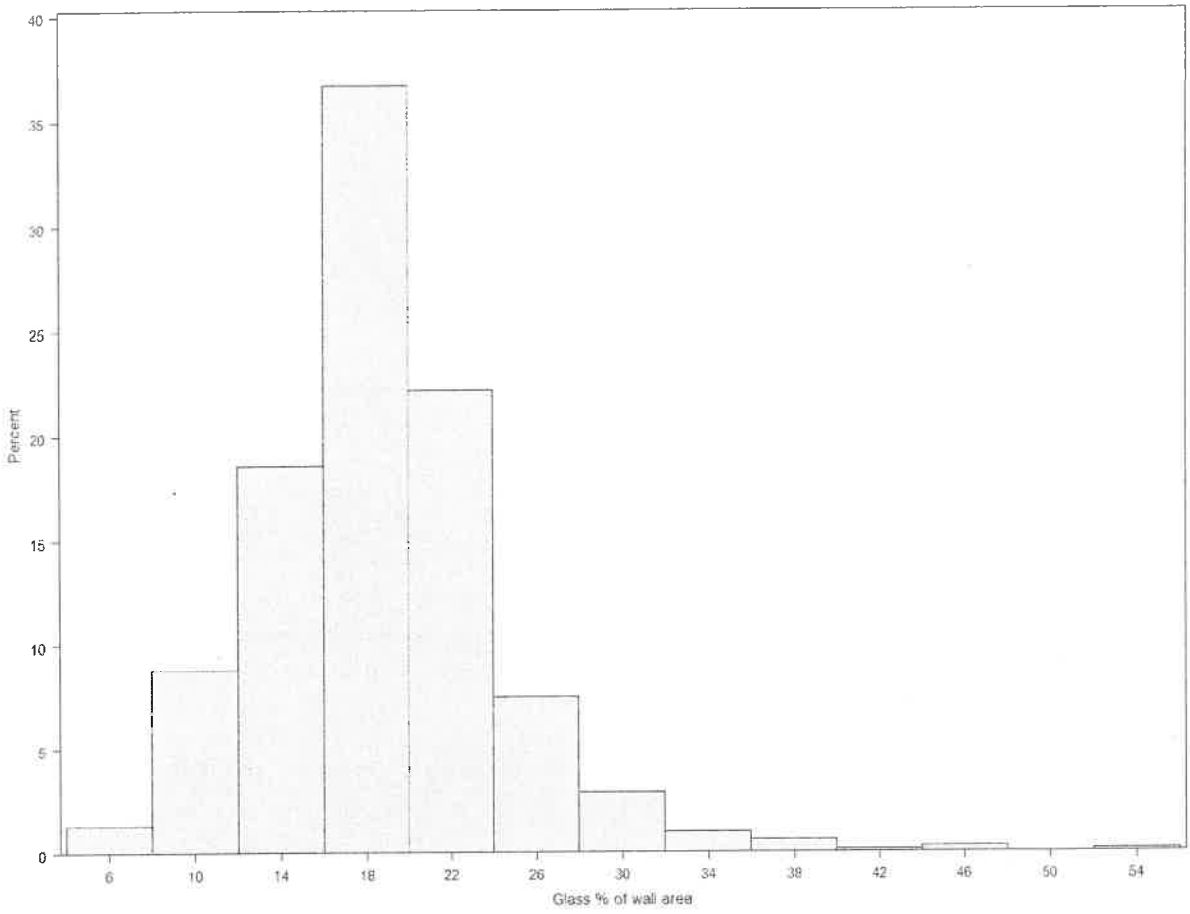

Figure 8. Distribution of Glass Area as a Percentage of Exterior Wall Area (H19)

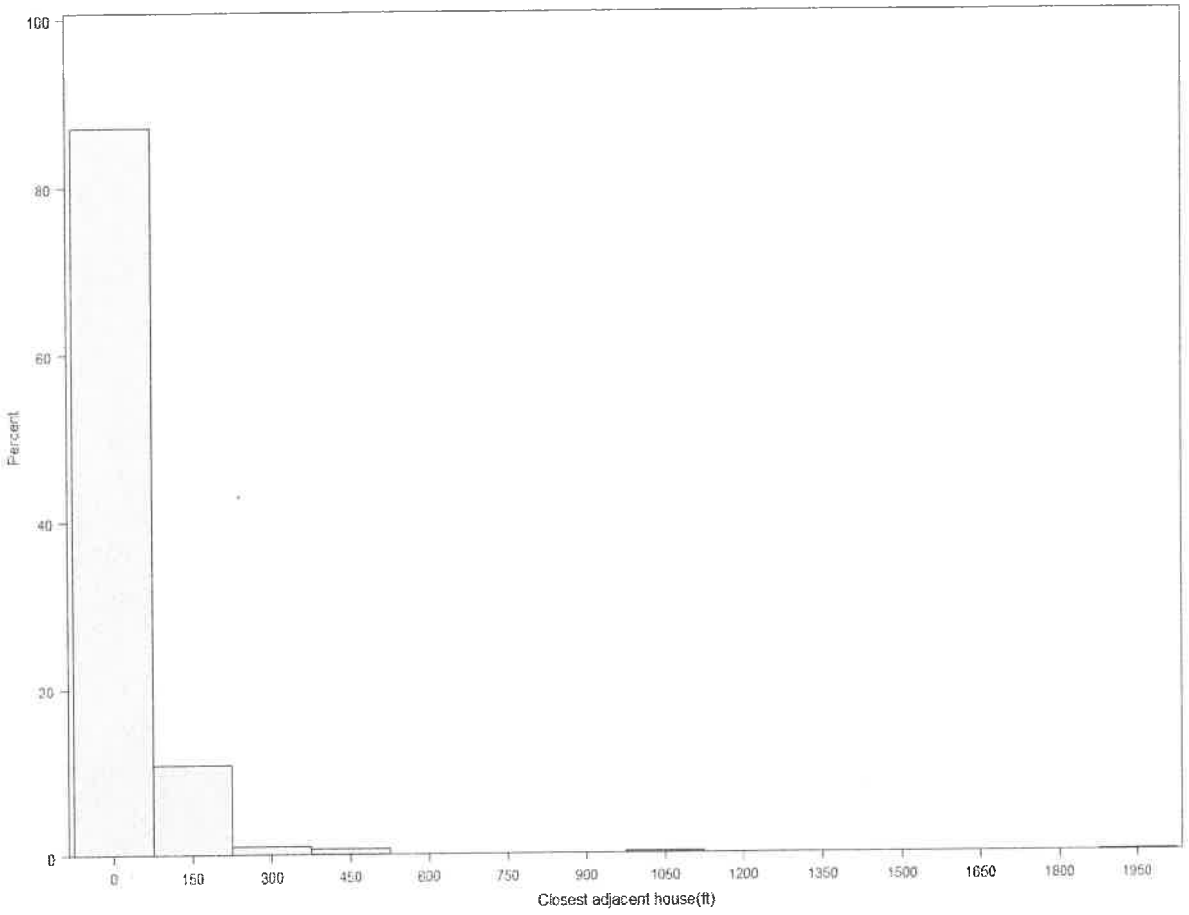

Figure 9. Distribution of Distance to Closest Adjacent House (I5)

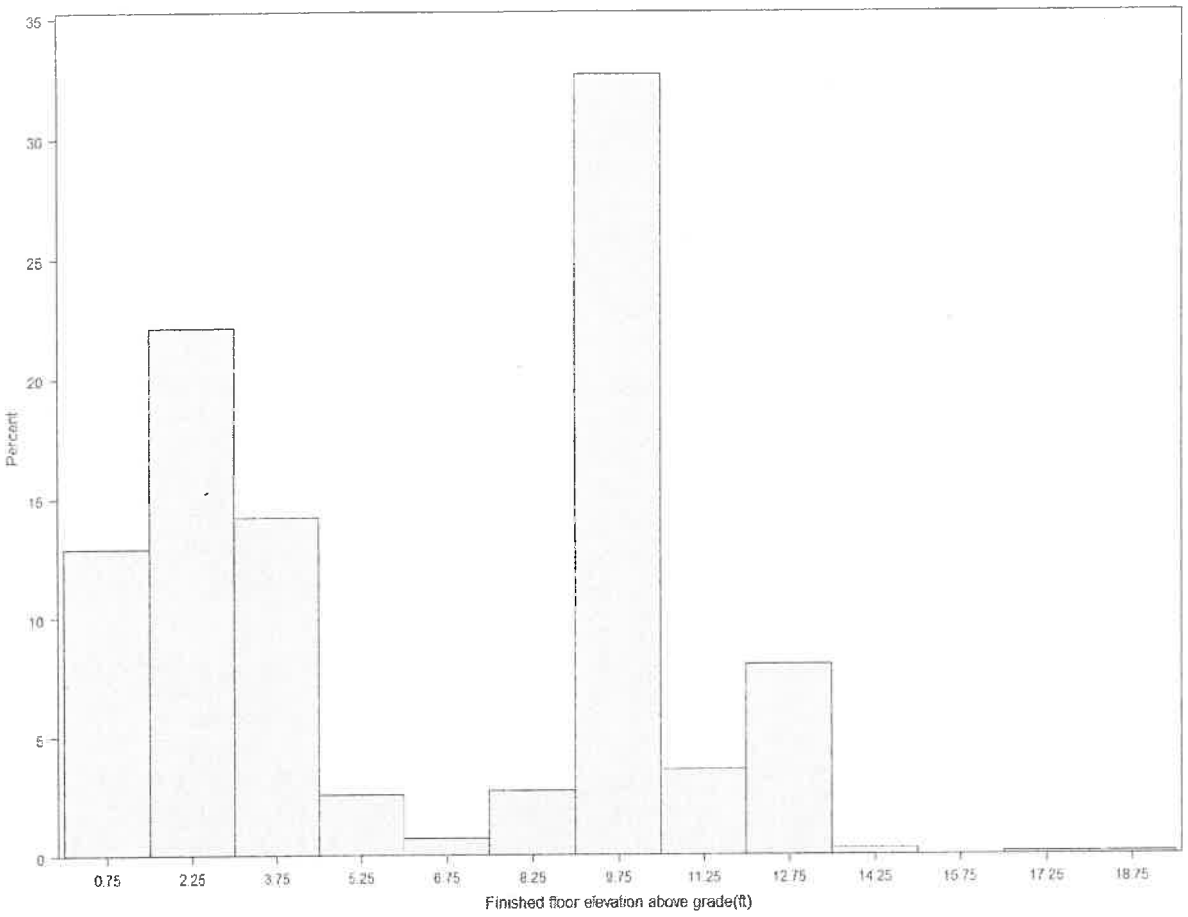

Figure 10. Distribution of Finished Floor Elevation above Grade (J1)

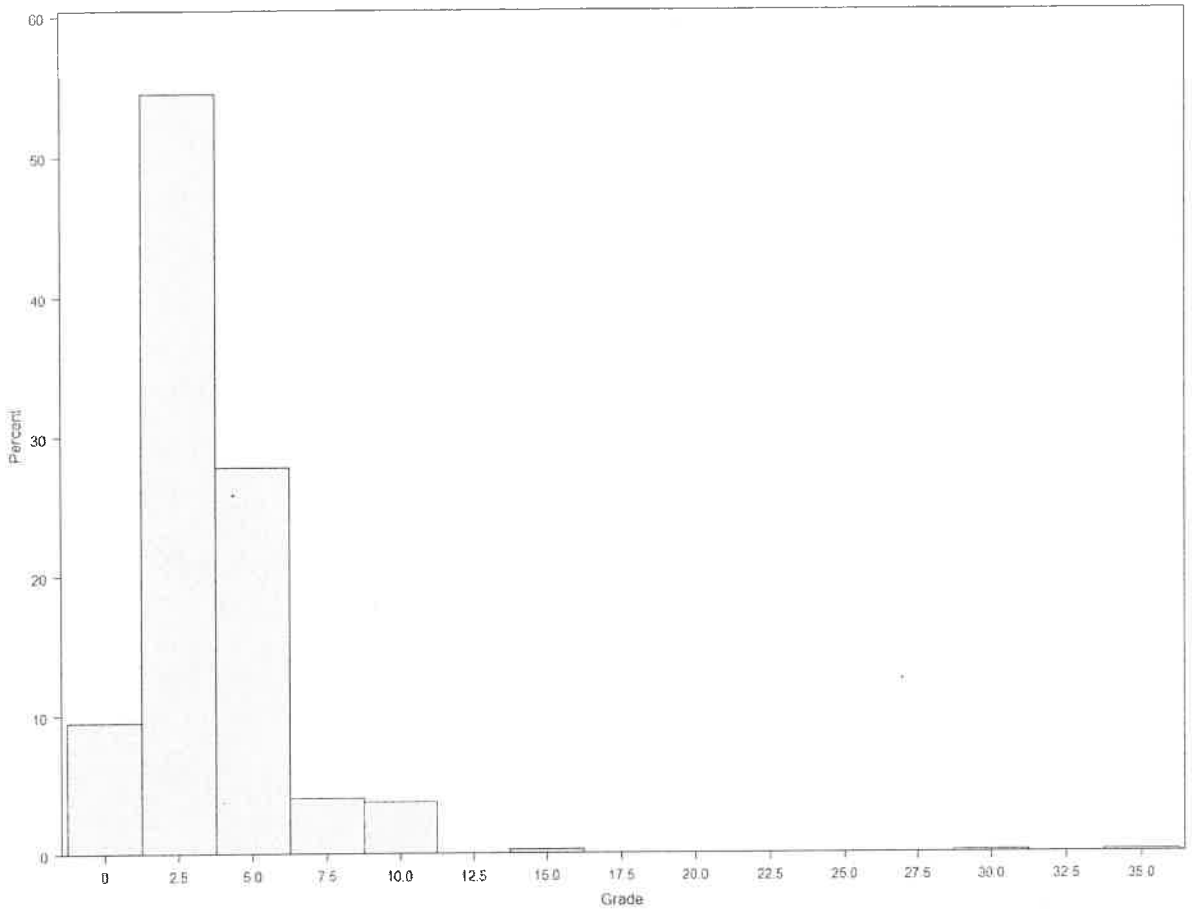

Figure 11. Distribution of Grade Elevation with Respect to NAVD-88 Datum (J1a)

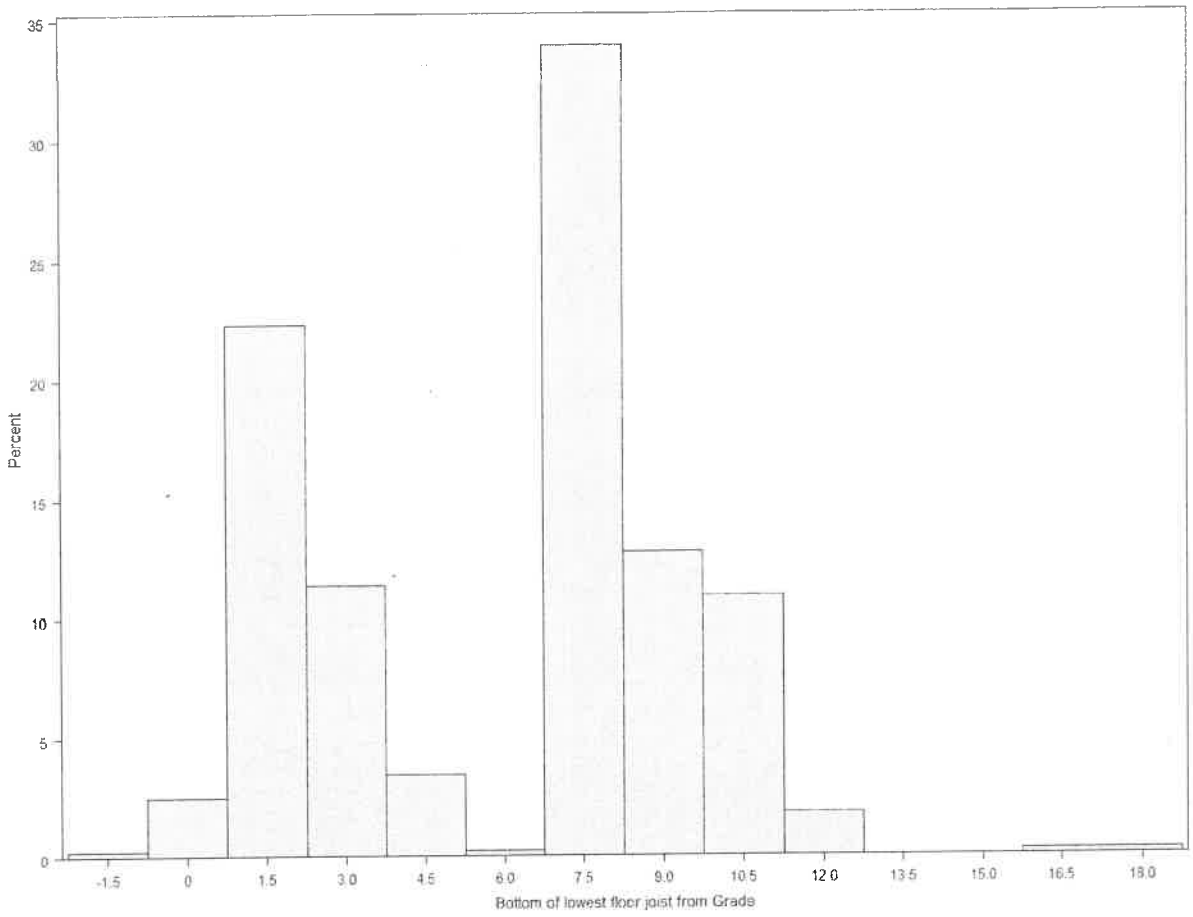

Figure 12. Distribution of Height above Grade to the Bottom of the Lowest Horizontal Floor Joist (J7)

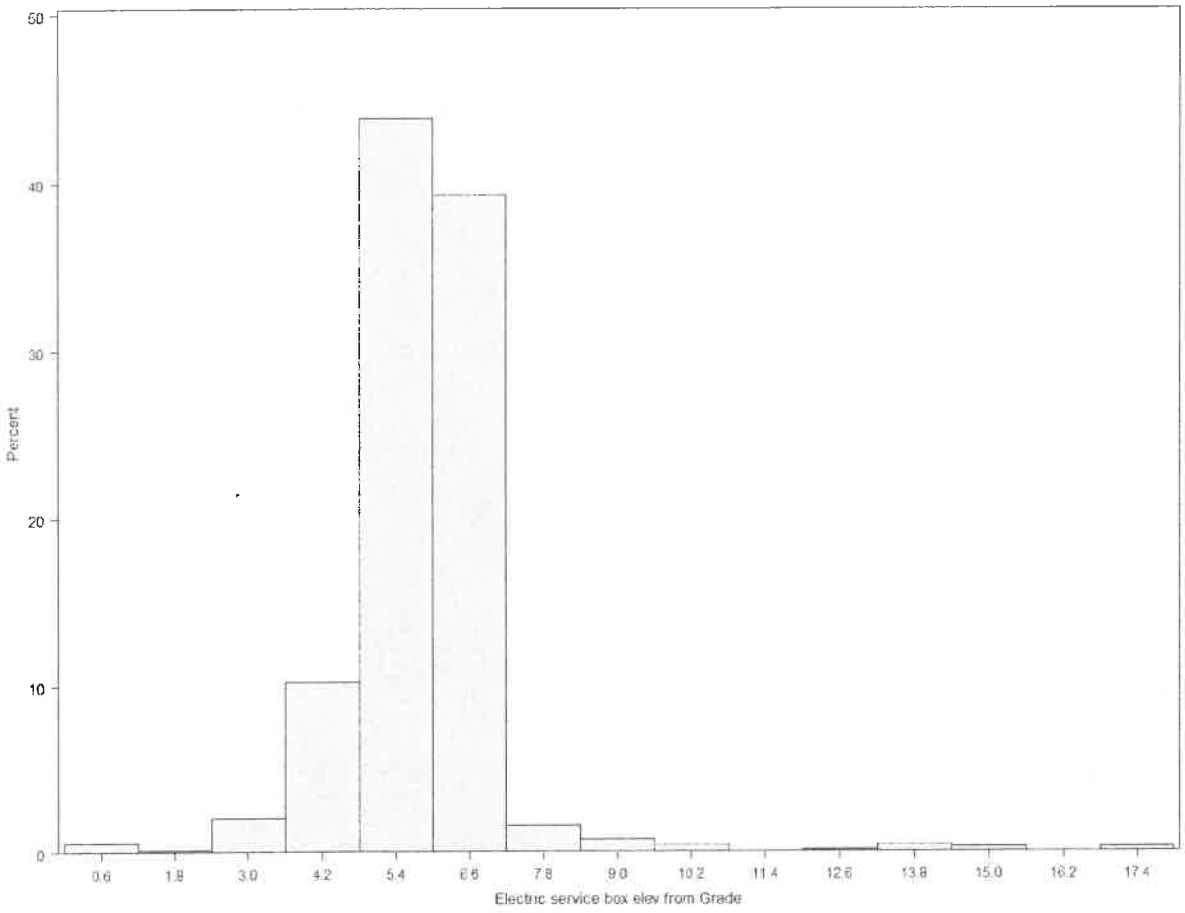

Figure 13. Distribution of Height above Grade of the Main Electric Service Box (J8)

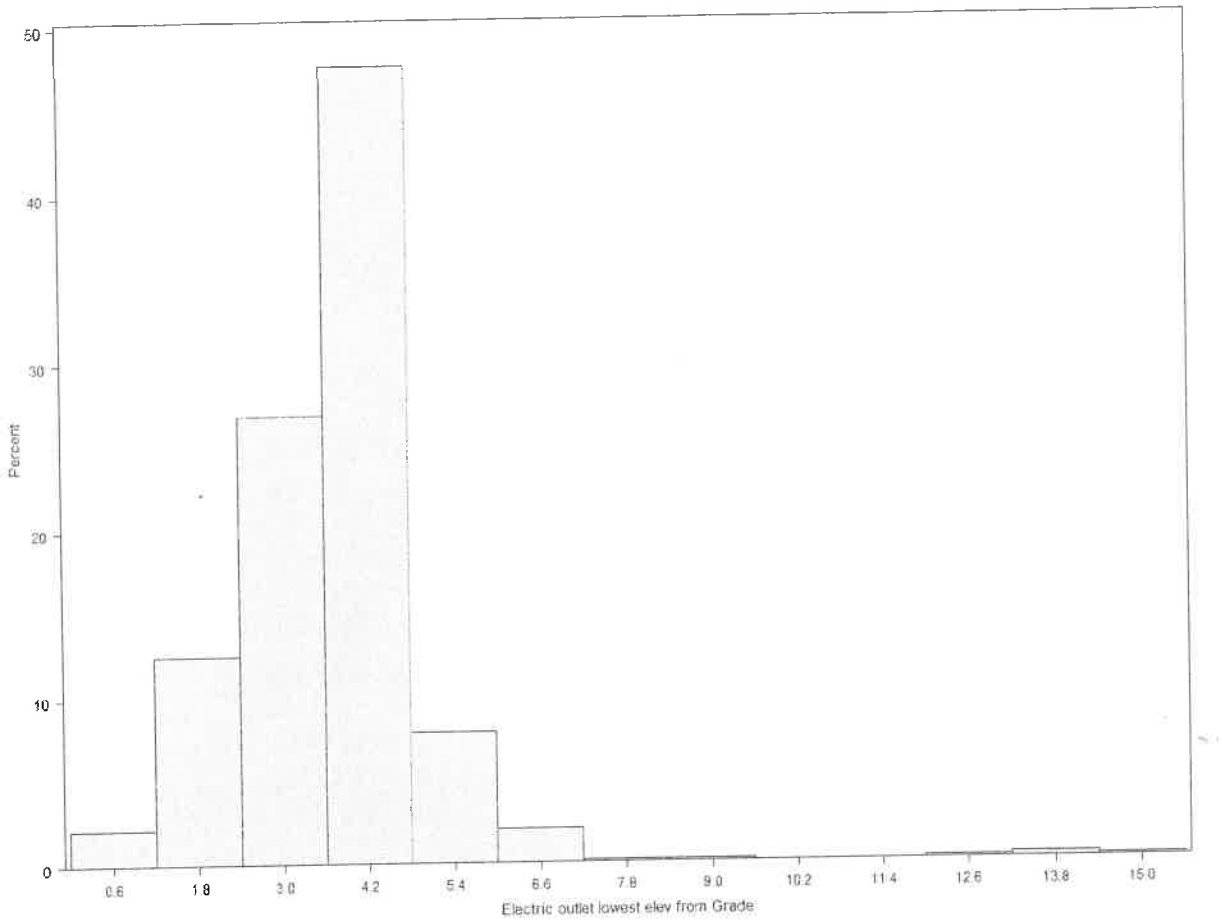

Figure 14. Distribution of Height above Grade of the Lowest Electrical Outlet (J9)

3.2 Results by Era

As expected, many of the variables surveyed exhibit significant dependencies on era of construction. The figures in this section provide several illustrations. In these figures, the bounds have been reduced by a factor of $1/\sqrt{2}$ so that any non-overlapping ranges are indicative of significant changes in the response rates at the 95% confidence level for the variable and response shown.

In Figure 15 and Figure 16, we see that the frequencies of the two most common types of construction, wood frame and reinforced masonry, vary significantly with year built era. Before 1941, the construction is almost entirely wood frame, but from 1941 through 1976, reinforced masonry is the more common type of construction. Although the best estimate frequency of masonry construction increases from 64% to 77% from the second and to the third era (Figure 16), we can see that the factored upper bound of the second era (73%) overlaps with the factored

lower bound of the third era (70%), indicating that the difference between the second and third eras is not statistically significant at the 95% level. There is also a slight overlap between the factored lower bound of the second era and the factored upper bound of the fourth era. However, the masonry construction frequencies in the second and third eras do differ significantly from each of the other five eras.

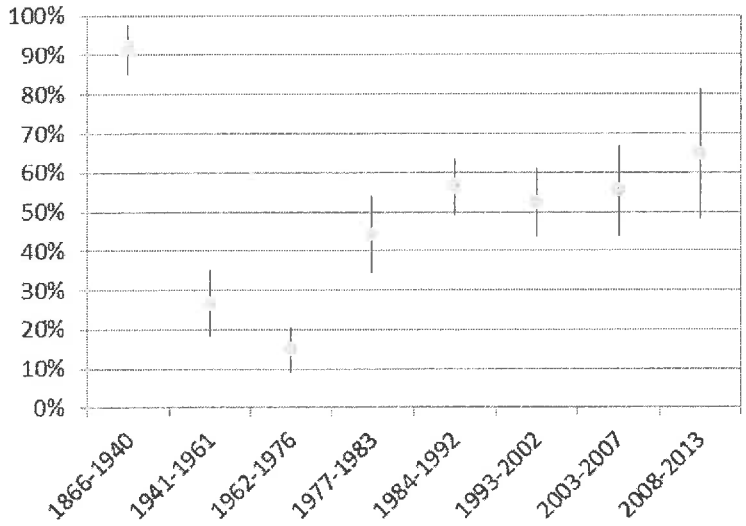

Figure 15. Distribution of Wood Frame Construction Frequency by Era (F4)

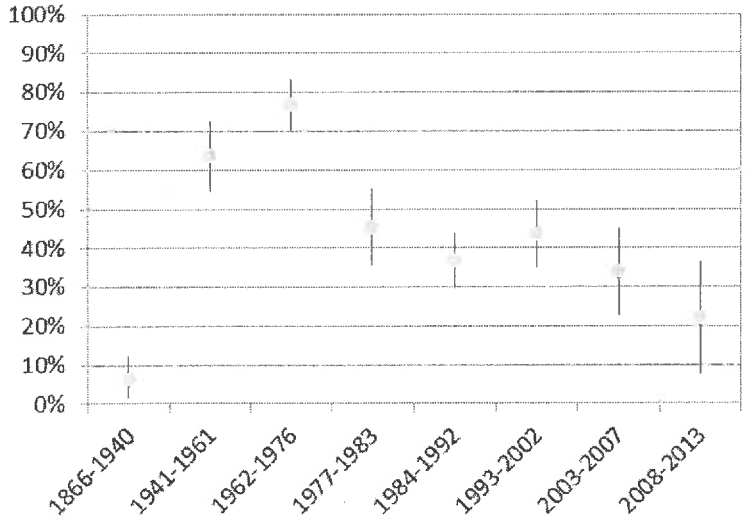

Figure 16. Distribution of Reinforced Masonry Construction Frequency by Era (F4)

Figure 17 and Figure 18 plot the frequencies of the two most common roof covering types by era of construction. Although notably higher in the earliest and most recent eras, the frequencies of V-crimp metal roofs by era (Figure 17) are not quite significantly different at the 95% confidence level. The same is true of the asphalt shingle roof frequencies (Figure 18), which tend to mirror the V-crimp metal roof frequencies.

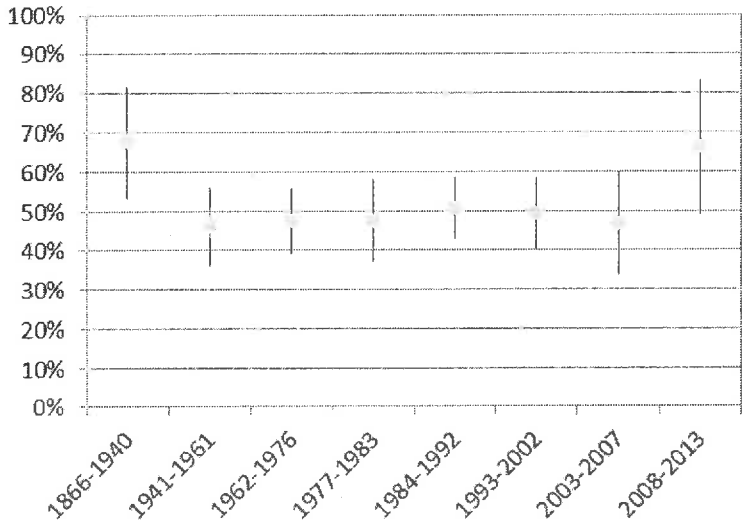

Figure 17. Distribution of V-Crimp Metal Roof Frequency by Era (G2)

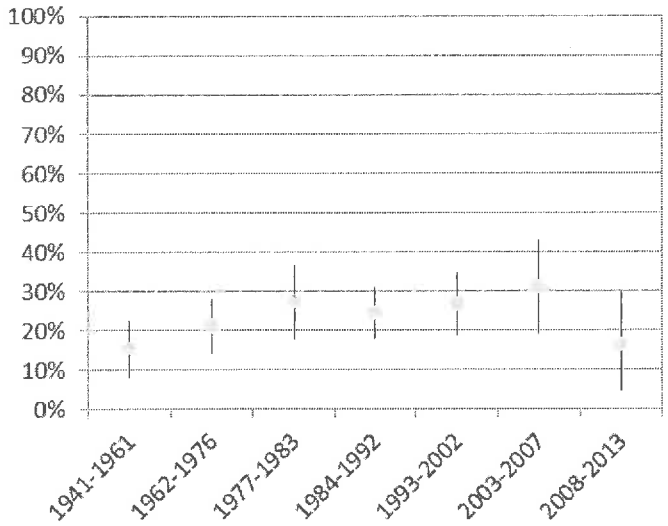

Figure 18. Distribution of Asphalt Shingle Roof Frequency by Era (G2)

Figure 19 and Figure 20 plot the frequencies of the two most common roof deck attachment types with era of construction. Figure 19 plots the frequency of 8d@6/12 nailing (i.e., 8 penny nails at no more than 6-inch spacing along the edges and 12-inch spacing in the field), and Figure 20 plots the frequency of 8d@6/6 nailing. It can be seen that the frequency of the stronger 8d@6/6 nailing increases with each successive era beginning with the 1977-1983 era, to the point where the 8d@6/12 frequencies begin to decrease in the two most recent eras after being above 60% for each of the three eras from 1977-2002.

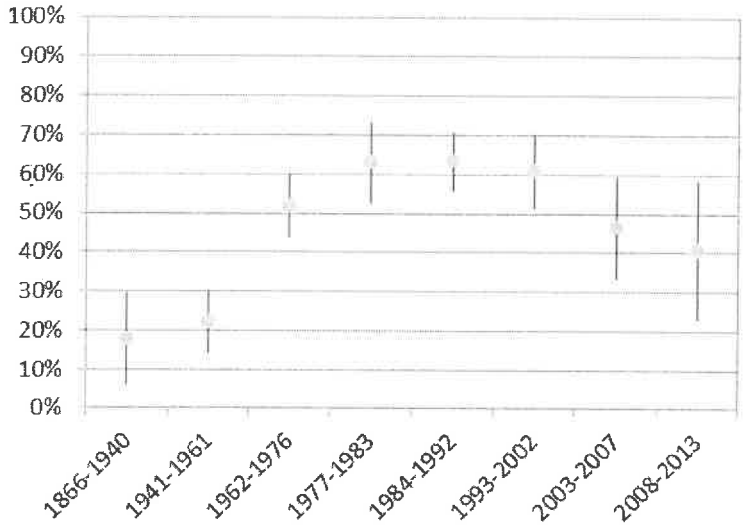

Figure 19. Distribution of 8d@6/12 Roof Deck Attachment by Era (G3)

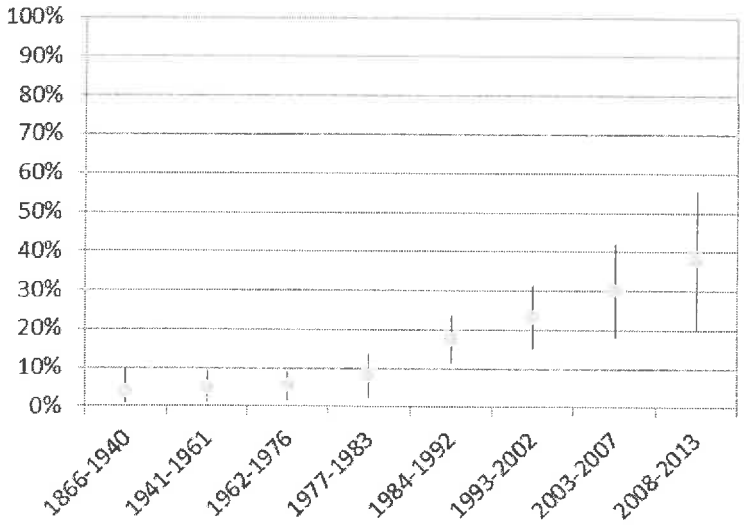

Figure 20. Distribution of 8d@6/6 Roof Deck Attachment by Era (G3)

Figure 21 and Figure 22 plot the frequencies of the two most common roof-to-wall attachment types, hurricane clips and single wrap straps, by construction era. Surprisingly, the trends in roof-to-wall connection are not very pronounced. The best estimates for clipped connections range from 32% to 57%, but with no consistent trend. Likewise, the best estimates for single wrap strap connections range from 17% to 40% with no consistent trend.

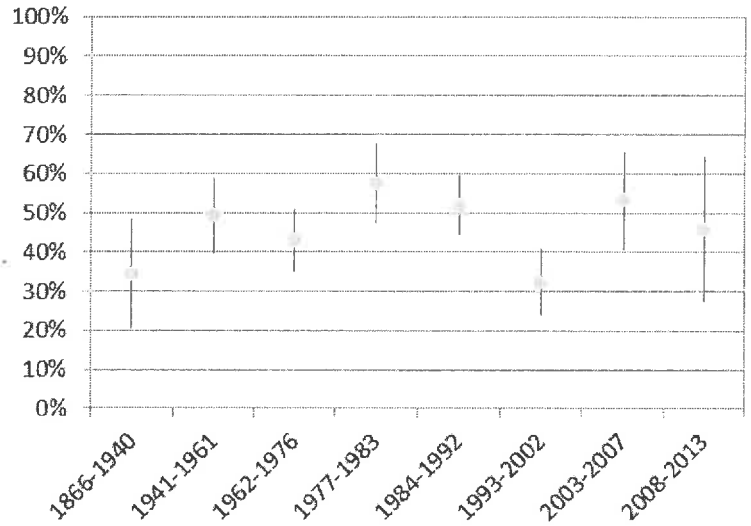

Figure 21. Distribution of Clipped Roof-to-Wall Connections by Era (G4)

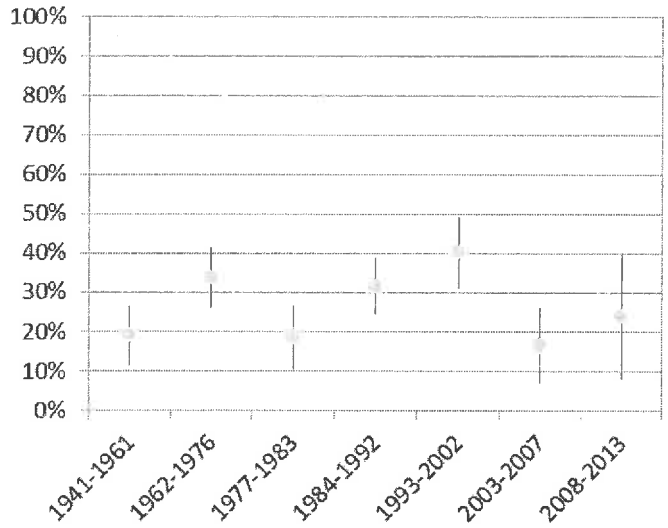

Figure 22. Distribution of Single Wrap Roof-to-Wall Connections by Era (G4)

Figure 23 plots the frequencies and confidence intervals for hip roof shapes by construction era. For this construction characteristic, there is a steady upward trend to a peak of 44% in the 1993-2002 era, followed by a decline to17% in the 2008-2013 era. At the 95% confidence level, the frequencies of hip roofs are significantly higher during the 1984-2002 period than the two earliest eras or the most recent era.

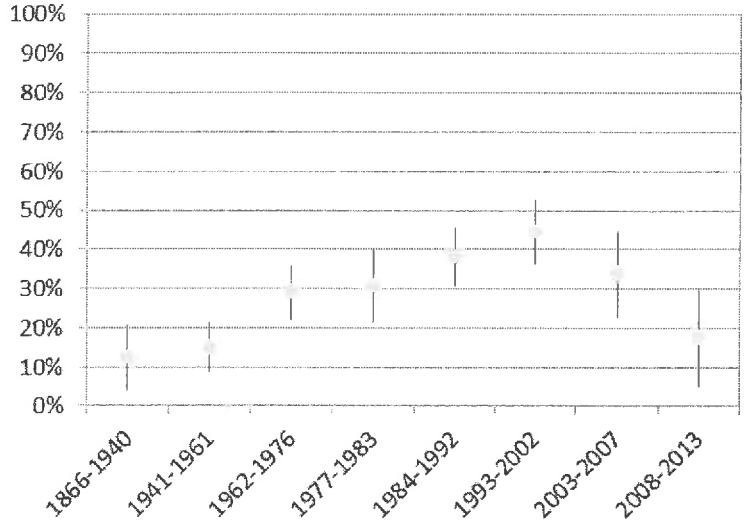

Figure 23. Distribution of Hip Roof Percentage by Era (G5)

Figure 24 plots the frequencies and confidence intervals for the presence of a secondary water barrier underneath the main roof covering system by construction era. No clear trend is observed for this feature, which likely due to variations in the roofing systems used over time, the irregular intervals at which buildings are re-roofed, and the availability of secondary water resistance systems that can be applied the underside of roof decks without re-roofing.

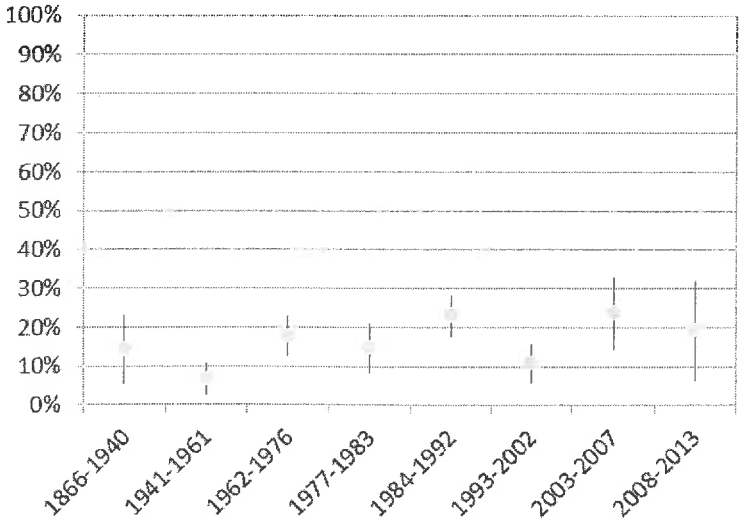

Figure 24. Distribution of Secondary Water Resistance by Era (G6)

Finally, Figure 25 plots the frequency of Type A opening protection (verified for cyclic pressure and large missile (9-lb for windows and doors / 4.5-lb for skylights)). Here, we see a strong upward trend with construction era. There is a small, but statistically insignificant, reversal in the 1984-1992 era.

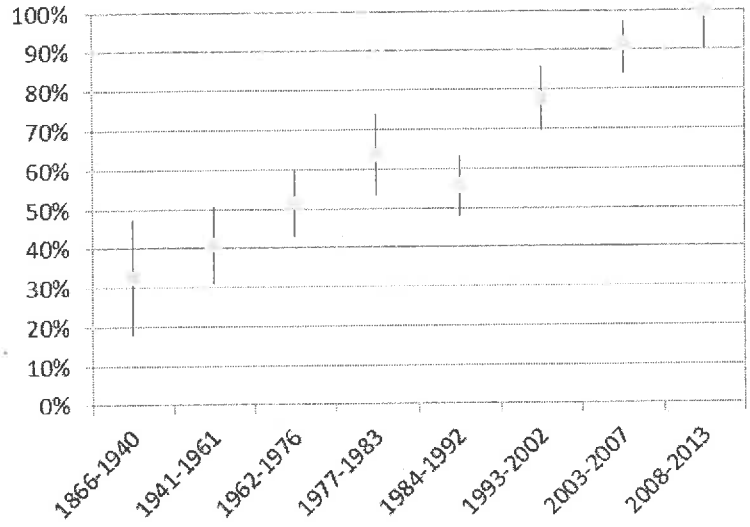

Figure 25. Distribution of Opening Protection Level A by Era (G7)

3.3 Results by Location and Era or Building Value and Era

In addition to the eight construction eras, the survey was also design around two locations (Key West and Not Key West) and two building valuation groupings (Lower 3 Quartiles and Top Quartile). In this section, we present examples of location and value effects.

First, we compare the frequency of V-crimp metal roof covering in Key West (KW) to the rest of the county (NKW). For this comparison, we have chosen the houses in the lower three quartiles of building valuation (Lr3Q) since there are more houses in the Lr3Q group than in the TopQ group. As shown in Figure 26, there are four construction eras (1941-1961, 1962-1976, 1984-1992, and 1993-2002) with sufficient data to compute confidence intervals by era and location. In three of the four eras, the frequency of V-crimp metal roofs is significantly higher in Key West than it is in the rest of the county, and in the fourth era (1984-1992), the difference is not statistically significant.

Next, we compare the frequency of opening protection level A in Key West (KW) to the rest of the county (NKW). Again, for this comparison we choose the houses in the lower three quartiles of building valuation (Lr3Q) since there are more houses in the Lr3Q group than in the TopQ group. For this feature, Figure 27 shows that there are no construction eras in which the KW frequency differs significantly from the NKW frequency.

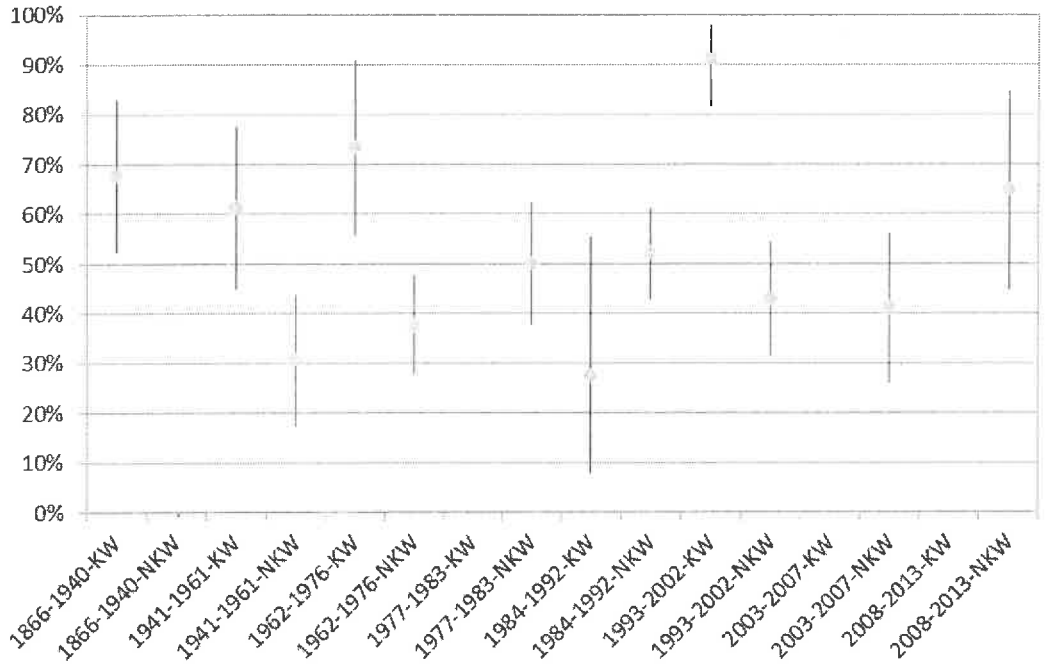

Figure 26. Distribution of V-Crimp Metal Roof Frequency by Era and Location within the Lower Three Quartiles of Building Valuation (G2)

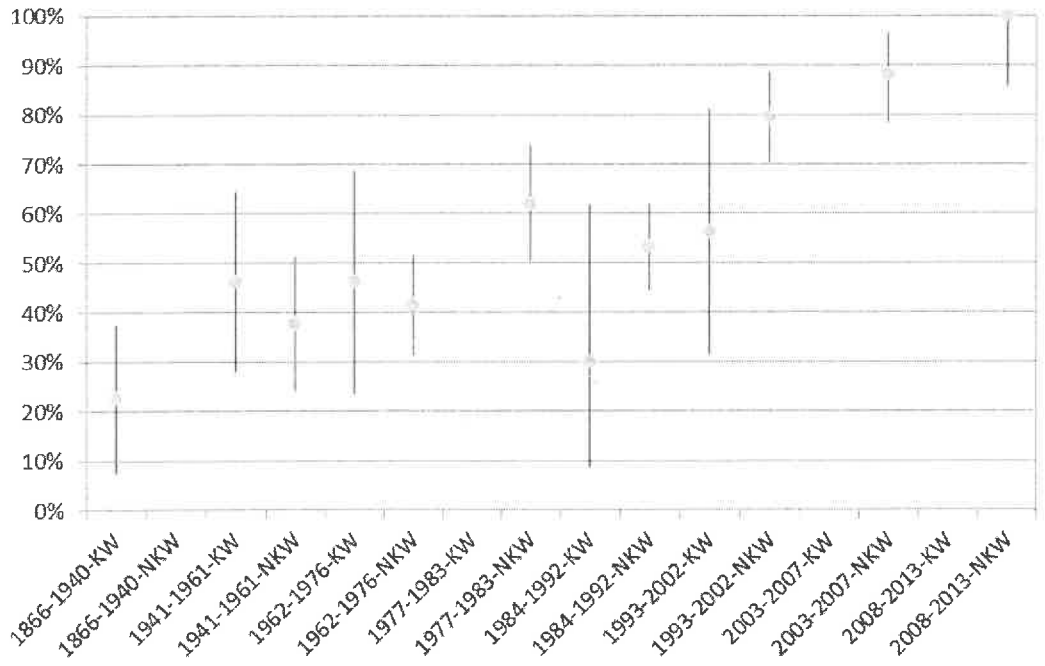

Figure 27. Distribution of Opening Protection Level A Frequency by Era and Location within the Lower Three Quartiles of Building Valuation (G7)

Finally, in Figure 28 we compare the frequency of opening protection level A by era and building value. For this comparison, we have chosen the houses outside Key West (NKW) since there are more houses in the NKW group than the KW group. Here, we see for houses built between 1962 and 2007 that the houses in the top quartile of building value are more likely to have opening protection level A than houses in the lower three quartiles of building value. However, the only era in which the difference is statistically significant is the 1962-1976 era.

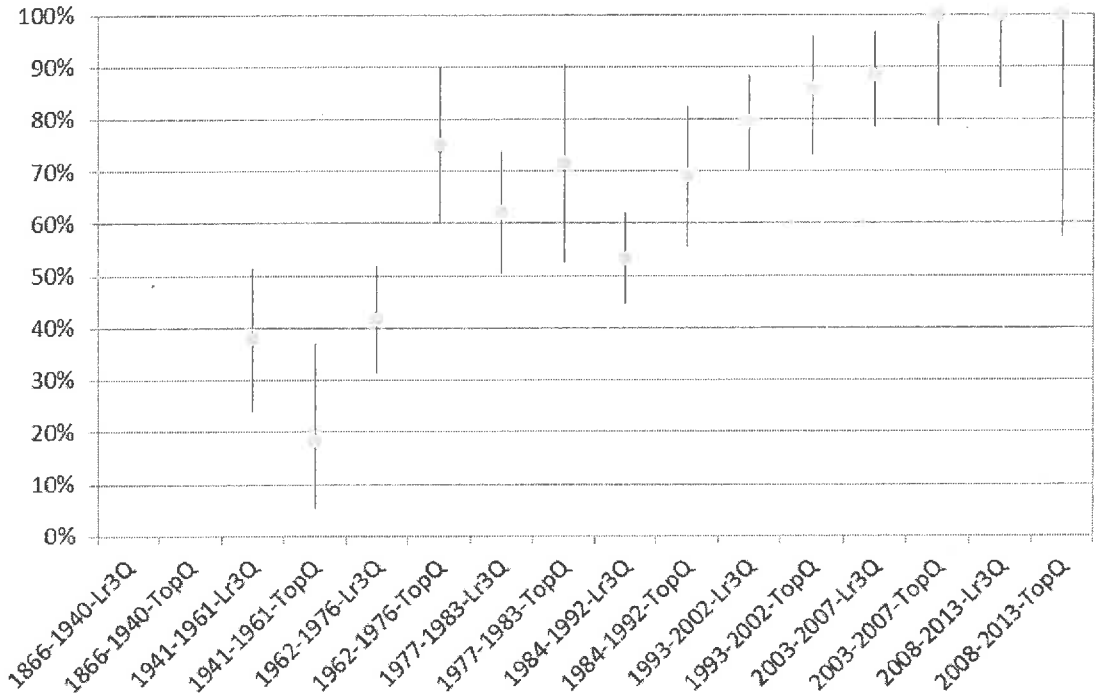

Figure 28. Distribution of Opening Protection Level A Frequency by Era and Value outside Key West (G7)

4. Summary and Conclusions

Information from the Monroe County Property Assessor database has been combined with existing wind mitigation characteristics from the Citizens Property Insurance Corporation and publicly available wind mitigation studies to develop an optimized stratified sampling plan for Monroe County. The selected stratification variables are year built (8 eras based on local building code history and construction practices), location (Key West and the remainder of Monroe County), and building value (lower 3 quartiles and top quartile). The resulting sampling plan is summarized in Table 4 in Section 2.4.

The inspections collected information on 74 variables that are either currently used in commercial catastrophe models for projecting hurricane wind and storm surge losses or that may be important in the modeling of wind and storm surge losses. Most of the variables are categorical (e.g., roof shape: hip, gable, flat, …), but a few are quantitative (e.g., square footage, first floor elevation, …). For the categorical variables, consolidated lists of possible responses were developed based on reviews of publicly available model documents to encompass the range of options currently available in the four FCHLPM-approved commercial models. A complete listing of the variables and responses is given in Section 2.1 and examples of completed checklists are provided in Appendix A.

Using the best estimate and uncertainty interval expressions given in Appendix C, Table 5 in Section 3.1 provides the Monroe County population estimates for each possible response for each of the 74 variables in the survey. The lower and upper bounds of the 95% confidence interval are provided for each estimate. For each quantitative variable, histograms of the survey results are provided in Figure 1 through Figure 14.

In Section 3.2, several of the key wind mitigation variables are examined for trends with construction era. As expected, significant differences are noted by year built era in several key variables, including: wall construction, roof covering, roof deck attachment, roof-to-wall attachment, roof shape, and opening protection. Examples of further significant differences with respect to geographic location within the county and building value are provided in Section 3.3. Trends with respect to location and value should be considered only within each of the eight construction eras, as the development histories inside and outside of Key West and the building valuations are each dependent on year built.

As illustrated throughout Section 3, the inspection results can be tested for significant differences from a multitude of different perspectives. However, any statistically significant differences are only important to the extent that they significantly impact modeled hurricane wind and storm surge losses in Monroe County. The extent of these impacts will vary by catastrophe model and will depend on the how the variables and their possible responses propagate through each catastrophe model into modeled losses. To understand how the responses affect modeled losses, a series of sensitivity studies will be required with each of the relevant catastrophe models to prioritize the variables and responses that have the largest impacts on Monroe County hurricane wind and storm surge losses. To the extent possible, the model results will then need to be validated against historical events and detailed engineering analysis to determine which catastrophe model best represents the level of risk in Monroe County, as it is known that there is a wide disparity among approved catastrophe models regarding the Monroe risk.

5. References

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Twisdale, L.A., M.A. Young, and P.J. Vickery (2002). *Development of Loss Relativities for Wind Resistive Features of Residential Structures*, Florida Department of Community Affairs, Tallahassee, Florida, March.

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Appendix A: Survey Forms Examples

Sections A through E of the survey form included fields for: (A) inspector information, (B) contact information, (C) house location, (D) wind insurance, and (E) flood insurance. The information in these sections was collected for administrative purposes in the case of Sections A, B, and C or was not collected in the case of Sections D and E. Examples of these sections are not shown below.

An example of Sections F and G from Version 1 of the Survey Form is shown below. Version 1 was used for the first 105 inspections.

General info				
F1	Year built	1976		
F2	Occupancy	One-Family		
F3	Configuration	Detached		
F4	Construction	4 Reinforced Masonry		
F5	Stories	1		
F6	Floor Area (Heated/Cooled)	935	Sq.Ft	
F7	Overall building condition	Good		
UMVIF Info -- see OIR-B1-1802 PDF (Items G1, G2, G6 & G7 may require supporting docs such as permits, drawings, specs or affidavits)				
G1	Building code	Was the Structure built in compliance with the Florida Building Code (FBC 2001 or Later) OR for homes located in the HVHZ (Miami-Dade or Broward Counties), South Florida Building Code (SFBC-94)?		
		C - N/A		1976
G2	Roof covering	3 Metal: V-crimp		
G3	Roof deck attachment	What is the weakest form of roof deck attachment?		
		9 Dimensional lumber / Tongue & groove decki		
G4	Roof to wall attachment	What is the weakest roof to wall connection? (Do not include attachment to hip/valley jacks within 5 feet of the inside or outside corner of the rood in determination of weakest type)		
		2 Clips		
G5	Roof Geometry	3 Gable		
G6	SWR	Secondary Water Resistance (SWR): (standard underlayments or hot-mopped felts do not qualify as SWR)		
		C Unknown or Undeterm		
G7	Opening Protection	None		Some openings do not have protection

Section G was expanded in Version 2, which was used for inspections 106 through 699. An example of the expanded Section G is shown below:

UMVIF Info -- see OIR-B1-1802 PDF (Items G1, G2, G6 & G7 may require supporting docs such as permits, drawings, specs or affidavits)

G1 Building code: C - N/A

Was the Structure built in compliance with the Florida Building Code (FBC 2001 or Later) OR for homes located in the HVHZ (Miami-Dade or Broward Counties), South Florida Building Code (SFBC-94)? 1970

App. Date:

G2 OIR

Type / Select all types in Use	Permit App. Date	FBC/MDC Prod Appr #	Year Installed	No Docs
3 - Metal*	unknown	unknown	unknown	unknown

Strength: B - All have MDC product approval listing current at time of installation

If ASTM rated, indicate: ☐ D-3161 Class F ☐ D-7159 Class G ☐ D-7159 Class H Other:

Roof covering: 3 Metal: V-crimp Fasteners: 3=Screws

Attachment Type *	Fastener Diameter (in)	Fastener Length (in.)	Fastener Spacing w.r.t. trusses/rafters Parallel (inches)	Perpendicular (in.)
1 - Metal with exposed fastener	#8	2 1/4	12	12

Gutters: No

G3 Roof deck attachment — What is the weakest form of roof deck attachment?

Consolidated List: 10 Dimensional lumber / Tongue & groove decking with

OIR: Describe Other:

G4 Roof to wall attachment — What is the weakest roof to wall connection? (Do not include attachment fo hip/valley jacks within 5 feet of the inside or outside corner of the rood in determination of weakest type)

Consolidated List: 3 Single wraps

3 Gable

OIR: C - Single Wraps

G5 Roof Geometry

G6 SWR — Secondary Water Resistance (SWR): (standard underlayments or hot-mopped felts do not qualify as SWR)

C Unknown or Undetermined

G7 OIR

Opening Level Protection				Non-Glazed Openings		
Glazed Openings						Weakest Non-Glazed
Windows or Entry Doors	Garage Doors	Skylights	Glass Block	Entry Doors	Garage Doors	
N - Unverified A or B	N/A	N/A	N/A	N/A	N/A	

Sections H through J were the same in both versions. An example is shown below:

Other Wind Info - Building							
H1	Level of engineering	0 Unknown					
H2	Braced gables?	No					
H3	Roof slope	4	/12;	15	degrees		
H4	Roof cover attachment	3=Screws					
H5	Roof cover age (years)	unknown	years; (or year installed)				
H6	Roof cover condition	Good					
H7	Roof vents	No					
H8	Parapets	No					
H9	Dormers	No					
H10	Soffit material	Wood					
H11	Eave height	9	Feet above average adjacent ground				
H12	Overhang/rake	13-36 Inches					
H13	Flashing/coping	Good Cond.					
H14	Rooftop equipment	No					
H15	Rooftop equip. anchorage						
H16	Exterior wall construction	Masonry					
H17	Exterior wall covering material	10 Stucco	Impact:	0 Unknown			
H18	Exterior wall covering condition	Good					
H19	Glass percent	25	% of wall area				
H20	Window glass types (check all appl.)	☑ Annealed	☐ Tempered	☐ Heat Str.	☐ Laminated	☐ Plastic/Acrylic	☐ Unknown
H21	Window glass const (check all appl.)	☑ Sgl. Pane	☐ Insulated	☐ Unknown			
H22	Door glass types (check all appl.)	☐ None	☐ Annealed	☑ Tempered	☐ Heat Str.	☑ Laminated	☐ Plastic/Acrylic
H23	Door glass const (check all appl.)	☐ N/A	☑ Sgl. Pane	☐ Insulated	☐ Unknown		
H24	Door configuration (check all appl.)	☑ Single	☐ French	☑ Double	☐ Slider		
H25	Door construction (check all appl.)	☐ Unknown	☐ Hollow	☑ Solid	☐ Reinforced		
H26	Garage configuration	No					
H27	Garage doors sizes (check all appl.)	☐ Single	☐ Double-16'	☐ Double-18'			
H28	Carports	No					
H29	Fences	Yes					
H30	Enclosed porch	No					
H31	Screened porch	No					
H32	Open porch/balcony	Yes		240		Non-Integral	
H33	Shed	Detached		Non-Integral			
H34	Pool cage (metal screened enclosure)	No					
H35	Other exterior structures?	No					

Other Wind Info - Surroundings					
I1	Distance to coast > 1500 ft	No	572	ft.	
I2	Exposure category	D			
I3	Avg. adj. building height (stories)	1.5	(stories)		
I4	Tree fall hazard	Yes	>5" diameter trees (measured at breast height) within striking distance		
I5	Closest adjacent house(ft)	25	(ft)		
I6	Small debris hazard (roof ballast)	Yes	10	(ft)	
I7	Large debris hazard	Yes	10	(ft)	

Flood Info (note J4 and J5 may also apply to wind modeling)					
J1	Finished floor elevation above grade	2	(ft)		
	Grade	3			
J2	Grade datum	NAVD88			
J3	Grade source	Monroe County GIS			
J4	Foundation type	5 Mat/slab			
J5	Wall/Floor to Foundation connection	9 Continuous structural connections (e.g., lapped rebar in poured-in-place concrete)			
J6	Wet flood proofing above FFE?	No	Ht. above/below Grade:		
J7	Bottom of lowest floor joist	ht. above/below Grade:	N/A	concrete	
J8	Electric service box elev.	ht. above/below Grade:	5		
J9	Electric outlet lowest elev.	ht. above/below Grade:	3.5		
J10	Heat pump	No			
J11	Air Conditioning Equip.	Yes	Ht. above/below Grade	0.5	
J12	Furnace	No			
J13	Pool	No			
J14	Pool equipment	No			
J15	Enclosed area below FF?	No	Sq Feet:		
J16	Enclosed area has flood vents?	N/A			
J17	Enclosed area has breakaway walls?	N/A			

Appendix B: Optimal Stratified Sampling

Given K strata with sample sizes n_i (i = 1, 2, ..., K), the n_i must conform to the rule that $n_1 + n_2 + \ldots + n_K = n$ (i.e., the total sample size is the sum of the sub-sample sizes). Selecting these n_i optimally can be done in various ways. The following expressions, adapted from Kish (1965), define the algorithm used in this study to allocate the samples to each stratum in a manner that minimizes the variance of the sample estimates.

In general, for H strata, the weighted sample mean is:

$$\bar{x}_w = \sum_{h=1}^{H} W_h \bar{x}_h,$$

with a variance of:

$$\mathrm{Var}(\bar{x}_w) = \sum_{h=1}^{H} W_h^2 \, \mathrm{Var}(\bar{x}_h).$$

The weights, $W(h)$, frequently, but not always, represent the proportions of the population elements in the strata, and $W(h)=N(h)/N$. For a fixed sample size, that is:

$$N = \sum N(h)$$

$$\mathrm{Var}(\bar{x}_w) = \sum_{h=1}^{H} W_h^2 \, \mathrm{Var}(h) \left(\frac{1}{n_h} - \frac{1}{N_h} \right)$$

which can be made a minimum if the sampling rate within each stratum is made proportional to the standard deviation within each stratum:

$$n_h/N_h = kS_h$$

An "optimum allocation" is reached when the sampling rates within the strata are made directly proportional to the standard deviations within the strata and inversely proportional to the square roots of the costs per element within the strata:

$$\frac{n(h)}{N(h)} = \frac{KS(h)}{\sqrt{C(h)}}$$

or, more generally, when:

$$n(h) = \frac{K'W(h)S(h)}{\sqrt{C(h)}}$$

For this project, $W(h)=N(h)/N$ and the survey cost is assumed to be the constant in all strata.

References

Kish, L. (1965). *Survey Sampling*, Wiley. ISBN 0-471-48900-X.

Appendix C: Uncertainty Bounds on an Estimated Proportion

Uncertainty bounds on an estimated number of "successes" between 0 and n, the sample size, can be directly calculated using a Binomial distribution, B(n,p), where p is the true proportion of "successes". However, the distribution of the estimator of p, called *"p hat"*, $\hat{p} = \frac{x}{n}$ where x = # of "successes" in a sample of n, is not Binomial but, by the Central Limit Theorem, asymptotically Normal. Accordingly, it is common to use a Normal distribution, N(*mean,variance*), to get the bounds on $\hat{p}$ (Wallis 2013; Brown et al. 2001). For $n > 5$, the Normal approximation B(n,p) ~ N(np,npq), where q=*1-p*, is adequate for this (Box et al. 1978) if

$$\left|\left(\frac{1}{\sqrt{n}}\right)\left(\sqrt{\frac{q}{p}} - \sqrt{\frac{p}{q}}\right)\right| < 0.3 \qquad \text{(C-1)}$$

In that case, the bounds on estimate $\hat{p}$ are such that

$$Prob\left[\left(\hat{p} - z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}}\right) \le p \le \left(\hat{p} + z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}}\right)\right] = 1 - \alpha \qquad \text{(C-2)}$$

where the bounds themselves are bounded by [0,1] and where $\hat{q} = 1 - \hat{p}$, and $z_{\alpha/2}$ is a standard normal value, usually 1.96, such that P[|z| < $z\alpha_{/2}$] = 0.95 = 1 - 0.05 for the usual error rate, α = 0.05, giving a 95% confidence interval.

For the special cases, in which either no success have been observed or only success have been observed, we use the following (Simon 2008): "In medicine, the rule of three is used to provide a simple way of stating an approximate 95% confidence interval for p, in the special case that no successes ($\hat{p} = 0$) have been observed. The interval is (0, 3/n)." By symmetry, one could expect for only successes ($\hat{p} = 1$) the interval is (1-3/n, 1).

Multinomial Proportions: A χ^2 generalization of the normal approximation interval for a binomial p is a standard practice in the multinomial case, where $\hat{p}$ is the estimated proportion of one of m possible choices, with more elaborate formulas as alternatives (Gold 1963; Goodman 1965; Quesenberry and Hurst 1964). Here a form of Goodman's criterion is used, giving correct usage for the binomial case and reflecting the fact that m-1 values determine the m^{th} one.

$$\pm\sqrt{\chi^2_{1,\alpha/(m-1)}\frac{\hat{p}\,\hat{q}}{n}} \qquad \text{(C-3)}$$

which by definition of χ^2 is

$$\pm z_{\alpha/(2(m-1))}\sqrt{\frac{\hat{p}\,\hat{q}}{n}} \qquad \text{(C-4)}$$

Individually weighted observations: Where the cell proportions are estimated using weighted data, so that the sum of weights do not equal n, the sum of weights usually replaces n as a divisor (Steel and Torrie 1960; SAS Institute 1990). In this case, the sum of weights = n only over all 699 observations, so for any sub-grouping, the sum of weights within that group should replace n

in the above formulas for calculating $\hat{p}$ but not the denominator of normal approximation adequacy formula (C-1). Even though, by weighting, we want to represent population proportions as best as possible, the actual number of points used in the approximation should be greater than 5. The weights used are:

$$W_h = \frac{(N_h/N)}{(n_h/n)} \tag{C-5}$$

and are applied to each observation, where n_h is the number actually sampled from stratum h and N_h is the number in the total population of houses belonging to stratum h. So, the weight is the correct stratum proportion divided by that stratum's proportion in the sample of houses. This gives estimates more representative of the population of houses, resulting in:

$$\hat{p}_W = \frac{\sum_{h=1}^{H}\sum_{i=1}^{n_h} I_{h,i}\cdot W_h}{n_W} \tag{C-6}$$

where $I_{h,i}$ is an indicator function equaling 1 for a "success" out of m possibilities and 0 for the remaining m-1 possibilities. The weighted number observed is

$$n_W = \sum_{h=1}^{H} W_h \cdot n_h \tag{C-7}$$

and actual number observed is

$$n = \sum_{h=1}^{H} n_h \tag{C-5}$$

The actual n is used at the beginning, with $\hat{p}_W$ as an estimate of p, in the Normal approximation for the Binomial adequacy formula, and $\hat{p}_W$ and n_W are used from then on throughout.

References

Box, Hunter and Hunter (1978). *Statistics for Experimenters*, Wiley, p.13.

Brown, L. D., Cai, T. T., and DasGupta, A. (2001). "Interval Estimation for a Binomial Proportion". Statistical Science 16 (2): 101–133.

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Goodman, L. A. (1965). "On simultaneous confidence intervals for multinomial proportions," *Technometrics*, 7, 247-254.

Quesenberry, C. P., and Hurst, D. C. (1964). "Large-Sample Simultaneous confidence intervals for multinomial proportions," *Technometrics*, 6, 191-195.

SAS Institute Inc. (1990). *SAS Procedures Guide, Version 6, Third Edition*, Cary, NC, p.375.

Steve Simon (2008). "Confidence interval with zero events", The Children's Mercy Hospital, Kansas City, Mo.

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Wallis, S. A. (2013). "Binomial confidence intervals and contingency tests: mathematical fundamentals and the evaluation of alternative methods" (PDF). *Journal of Quantitative Linguistics* 20 (3): 178–208.

ATTACHMENT F

RMS Master Agreement

MASTER AGREEMENT

THIS MASTER AGREEMENT (the "Agreement") is entered into as of this 18th day of May, 2016 (the "Effective Date"), by and between Risk Management Solutions, Inc., a California corporation, with its principal office located at 7575 Gateway Boulevard, Newark, California 94560 ("RMS"), and Fair Insurance Rates in Monroe County with its principal office located at 442 Fleming Street, Key West, Florida ("Client") (each a "Party," and collectively the "Parties").

1. DEFINITIONS

1.1. "Addendum" means the document executed by the Parties' which sets forth additional terms and conditions for RMS to license to Client the Licensed System, for RMS to provide Hosting Services to Client, or for RMS to provide Consulting Services to Client, as applicable. Each Addendum will be deemed to be incorporated as part of this Agreement.

1.2. "Affiliate" means an entity that controls, is controlled by, or is under common control with Client (with "control" meaning ownership of more than 50 percent of the voting stock of the entity or, in the case of a non-corporate entity, an equivalent interest), and which is set forth in an Addendum. Client is responsible and liable for any and all acts and omissions of its Affiliates as if they were the acts and omissions of Client and the rights of such Affiliates shall only be enforceable by the Client on their behalf.

1.3. "Consulting Services" means consulting or other services to be performed by RMS as specified in a Work Order.

1.4. "Deliverables" means the tangible work product to be delivered by RMS as specified in a Work Order.

1.5. "Hosting Services" means the scope of services RMS provides to Client set forth in the applicable Addendum.

1.6. "Intellectual Property Rights" means any tangible and intangible: (i) copyrights and other rights associated with works of authorship throughout the world, including, but not limited to, copyrights, neighboring rights, moral rights, mask works, and all derivative works thereof; (ii) trademark and trade name rights and similar rights; (iii) trade secret rights; (iv) patents, designs, algorithms, utility models, and other industrial property rights, and all improvements thereto; (v) all other intellectual and industrial property rights (of every kind and nature throughout the world and however designated) whether arising by operation of law, contract, license, or otherwise; and (vi) all registrations, applications, renewals, extensions, continuations, divisions, or reissues thereof now or hereafter in force (including any rights in any of the foregoing).

1.7. "Licensed System" means the RMS Technology, in object code, Third Party Products, and related materials thereto licensed to Client, as set forth in an applicable Addendum, including any permitted updates and upgrades provided by RMS and all permitted copies made by Client.

1.8. "Personnel" means a Party's employees and contractors; provided, however, Client shall require any Client's contractors that are provided access to the Licensed System or RMS Confidential Information (as defined below) to agree in writing to only use the Licensed System and RMS Confidential Information on behalf of Client in accordance with this Agreement and any applicable Addendum and to maintain all RMS confidential information in strict confidence in accordance with this Agreement.

1.9. "Results" means the output data generated from the use of the Licensed System or Deliverables, or results provided to Client from Support or Consulting Services, and based upon Client's clients' or prospects' input data, but not including such input data.

1.10. "RMS Technology" means RMS' proprietary software, models, data and methodologies licensed to Client under an Addendum.

1.11. "Schedule" means the schedule attached to an applicable Addendum which sets forth, at a minimum, the RMS Technology licensed to Client, available Support and applicable fees.

1.12. "Support" means the installation, training, maintenance and other technical support services RMS provides, in connection with the Licensed System as set forth in an applicable Addendum.

1.13. "Third Party Products" means the third party software or data products for use with the Licensed System, which are identified in an applicable Addendum or otherwise embedded with the Licensed System. .

1.14. "Work" means the Consulting Services RMS performs and the Deliverables RMS provides under a Work Order.

1.15. "Work Order" means the document executed by the Parties that specifies the Work, including, as appropriate, a delivery schedule, fees, and special terms applicable to the Work.

2. AGREEMENT ARCHITECTURE

In the event of a conflict between the Agreement, any Addenda or any Work Order, the following order of precedence shall apply: (i) the applicable Work Order, (ii) the applicable Addendum, and (iii) the Agreement. Terms in an Addendum will apply solely to that Addendum unless otherwise stated therein and terms of a Work Order will apply solely to that Work Order unless otherwise stated therein.

3. FEES AND PAYMENT TERMS

3.1. Fees shall be set forth in the applicable Addendum or Work Order.

3.2. All fees set forth in the applicable Addendum or Work Order are exclusive of all taxes, fees and duties of any kind. Client shall pay any and all taxes (including, without limitation, sales, withholding, value-added and similar taxes) imposed on the Licensed System, on the Work provided by RMS, or the Hosting Services provided by RMS, or Client's uses thereof, other than taxes based on RMS' income.

3.3. Payment in full is due upon Client's receipt of invoice and is past due 30 days from the date of invoice. Client will reimburse RMS for any attorneys' fees, court costs, or other costs incurred in collecting delinquent payments. TIME IS OF THE ESSENCE IN CLIENT'S PERFORMANCE OF ITS OBLIGATIONS UNDER THIS SECTION 3.3.

4. TERM AND TERMINATION

4.1. This Agreement commences as of the Effective Date and shall remain in force until terminated as provided herein.

4.2. This Agreement and any or all Addenda may be terminated immediately in any of the following circumstances:

4.2.1. Except as set forth in Section 4.2.3 below, upon written notice to the other Party for any material breach not cured within 30 days of receipt of a notice specifying in detail the grounds upon which the non-breaching Party alleges that the other Party has breached this Agreement or any applicable Addendum. Furthermore, in the event of a material breach of any of its obligations by Client under this Agreement or any Addenda, including without limitation the failure to pay any amount when due, then, without limiting RMS' remedies under this Agreement or any Addenda, hereto, RMS may, at its option, suspend all licenses granted by an Addendum and suspend performance under any Work Order, until such material default or breach has been fully cured.

4.2.2. Upon written notice to Client by RMS upon the occurrence of any of the following events: (i) a receiver is appointed for Client or its property; (ii) Client makes a general assignment for the benefit of its creditors; (iii) Client is unable to pay its debts as they become due; (iv) Client commences, or has commenced against it, proceedings under any bankruptcy, insolvency or debtor's relief law, if such proceedings are not dismissed within 60 days; or (v) Client is liquidating, dissolving, or ceasing to do business in the ordinary course.

4.2.3. Upon written notice to Client if Client fails to obtain RMS' consent to an assignment under Section 14.6, or if Client breaches the license grant in an Addendum or its confidentiality obligations in Section 6.

4.3 Upon termination, expiration or completion of all Addenda and Work Orders, this Agreement may be terminated by either Party upon 30 days prior written notice to the other Party.

4.4 Upon termination or expiration of this Agreement or any Addenda, or upon termination or expiration of Client's license of any portion of the Licensed System: (i) within 10 days of the date of termination or expiration, at RMS' option, either return all copies of the Licensed System, if applicable, and any Confidential Information to RMS, or destroy the original and all copies and parts thereof; and (ii) within 10 days of the date of termination or expiration, certify in writing through a director or other officer that such delivery or destruction has been fully effected.

4.5 The following provisions will survive the expiration or termination of this Agreement: Sections 1-3, 4.4, 4.5, 6, 7.1 and 8-14.

5. CONFIDENTIALITY

5.1. "Confidential Information" means any documents, materials or information disclosed by one party (the "Disclosing Party") to the other party (the "Receiving Party") which (i) is in tangible, visual, or electronic form or communicated orally and clearly marked or identified as proprietary or confidential at the time of disclosure, (ii) given the nature of the information or circumstances surrounding its disclosure, should reasonably be considered as confidential or proprietary, or (iii) is RMS Technology, Work, and Deliverables which RMS licenses, provides or makes available to Client or its Affiliates. Notwithstanding the foregoing, Confidential Information does not include information (a) the Disclosing Party makes generally available to others without restrictions; (b) the Receiving Party rightfully receives from a third party which has disclosed such information without any obligation itself to maintain the confidentiality of such information; (c) the Receiving Party has or knows of prior to first receiving the Confidential Information; (d) the Receiving Party has independently developed without use of or reference to the Confidential Information; or (e) which is produced pursuant to an order or requirement of a court, administrative agency, or other governmental body without restrictions on subsequent use or disclosure; provided that the Receiving Party notifies the Disclosing Party promptly upon receipt of such order or requirement to enable the Disclosing Party to seek a protective order or otherwise prevent or restrict such disclosure.

5.2. The Receiving Party may use the Confidential Information solely for the purpose for which the Disclosing Party provided the Confidential Information (the "Purpose"). Notwithstanding the foregoing, either Party may provide Feedback to the other Party. Absent a separate agreement or unless otherwise expressly provided in writing at the time Feedback is given, the Party receiving the Feedback will be free to disclose and use Feedback as it sees fit and, notwithstanding anything to the contrary, without any obligation whatsoever to the other Party. As used in this Section 6, "Feedback" means suggestions, comments or other feedback provided by the Receiving Party with respect to the Disclosing Party's Confidential Information.

5.3. The Receiving Party will (i) not disclose Confidential Information to any third party; (ii) use Confidential Information only for the Purpose; (iii) limit the disclosure of the Confidential Information only to its Personnel who have a need to know, provided that the Receiving Party shall ensure that each of those persons to whom Confidential Information is to be disclosed is made aware of, and shall procure that such Personnel adhere to, the terms of this Agreement and any Addendum and Work Order as if it were a party to it; and (iv) use the same degree of care to prevent disclosure or use of the Confidential Information for other than the Purpose that it would use for its own Confidential Information (but in no case with less than a reasonable degree of care).

5.4. Unless otherwise agreed to in writing by the Parties, no license to the Receiving Party, under any patent, trademark, copyright, or any other Intellectual Property Right of the Disclosing Party, is either granted or implied by the disclosure of Confidential Information to the Receiving Party.

5.5. Each Party acknowledges that disclosure or use of the Confidential Information in breach of this Agreement would cause irreparable harm to the Disclosing Party for which monetary damages may be difficult to ascertain or are an inadequate remedy. Therefore, the Disclosing Party shall have the right, in addition to its other rights and remedies, to seek and obtain injunctive relief for any violation of this Agreement. In any such action, the Receiving Party agrees (i) not to raise any defense that the Disclosing Party has an adequate remedy at law; (ii) that irreparable harm would

result from disclosure or use of the Confidential Information in breach of this Agreement; and (iii) that the Disclosing Party shall not be required to post a bond if otherwise required to do so by the court.

6. WARRANTY

6.1. EXCEPT AS OTHERWISE EXPRESSLY STATED IN AN ADDENDUM, ANY CONFIDENTIAL INFORMATION, LICENSED SYSTEM, RESULTS, SUPPORT, HOSTING SERVICES, AND WORK ARE PROVIDED "AS IS," WITHOUT ANY WARRANTY OF ANY KIND. RMS DISCLAIMS ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE.

6.2. Without expanding the foregoing, Client agrees and acknowledges that the RMS Technology and the Licensed System which RMS may license to Client or which RMS may use to perform any Consulting Services and Support provided under this Agreement or an Addendum, is based on the scientific data, mathematical and empirical models, and encoded experience of scientists and specialists (including without limitation, earthquake engineers, wind engineers, structural engineers, geologists, seismologists, meteorologists, geotechnical specialists and mathematicians). As with any complex model, the Results may differ from actual results or results derived from use of other models. Furthermore, the accuracy of the Results and analyses based on the Results depends wholly or in part on the accuracy and quality of Client's input. Accordingly, RMS does not make any representation or warranty as to the accuracy, completeness, or certainty of any RMS Confidential Information, Results, Support and Work.

7. INDEMNIFICATION

7.1. As used in this Section 8, (i) "Claim" means any and all pending, actual or threatened third party claims, and any resulting losses, damages, liabilities, settlement, costs, or expenses of a Party (including legal expenses and the expenses of other professionals), as incurred, arising out of or relating to this Agreement or an Addendum, and (ii) indemnification extends to the officers, directors, employees and agents of the indemnified Party (and in the case of RMS, of RMS' affiliates), as applicable.

7.2. Each Party will defend, indemnify and hold the other Party harmless from and against any Claim that the indemnifying Party's negligent or willful acts or omissions result in bodily injury (including death) or damage to tangible property.

7.3. Except as otherwise set forth herein, RMS will defend, indemnify and hold Client harmless from and against any Claim that RMS Technology or Work infringes a third party's Intellectual Property Rights. RMS will have no liability under this Section 8.3 for Claims which arise out of or relate to (i) use of other than the then-most recent version of the Work or Licensed System provided to Client, (ii) use of the Work or Licensed System for which RMS has provided Client with modifications or substitute Work or Licensed System if the Claim could have been avoided thereby, (iii) modifications to the Work or Licensed System, other than modifications made by RMS, (iv) use of Third Party Products subject to Section 8.3.2 below or (v) Work performed or developed at the direction of Client, where Client specifies the means, manner or method of performing the Work or developing the Deliverable, and to the extent RMS did not exercise its independent judgment and discretion in performing the Work or developing the Deliverable.

8.3.1. If a third party enjoins or interferes with the reproduction, use, or distribution of the Work or Licensed System as expressly permitted by this Agreement or any Addenda, RMS will use reasonable commercial efforts to (i) obtain licenses which are necessary to permit Client to continue to use the Work or Licensed System; (ii) replace or modify the Work or Licensed System to permit Client to continue to use of the Work or Licensed System; or if in RMS' sole discretion (i) and (ii) are not commercially reasonable, then (iii) promptly refund to Client the amount equal to, as applicable, (a) the amount paid for any Work for which a third party enjoins or interferes with Client's use of the Work or (b) a prorated refund of license fees paid.

8.3.2. Notwithstanding anything to the contrary set out in this Section 8.3, RMS will defend, indemnify and hold Client harmless from and against any Claim based on any Third Party Products solely to the extent that RMS is indemnified by the licensor of such Third Party Products.

8.3.3. This Section 8.3 is RMS' sole obligation and Client's sole remedy for a Claim of infringement of a third party's Intellectual Property Rights.

7.4. Client will defend, indemnify and hold RMS harmless from and against any and all Claims arising out of or relating to a third party's use of or reliance on the Results or Work, or on any reports, analyses, conclusions, or

recommendations of Client (or any third party to whom Client has provided the Results or Work) based in whole or in part on the Results or Work, excluding Claims that may be due to RMS' gross negligence or willful misconduct.

7.5. For all indemnification obligations, the indemnified Party will give the indemnifying Party (i) prompt written notice of any actual or alleged Claim; (ii) sole control of the defense and settlement of such Claim; and (iii) all information, reasonable assistance, and authority to fully defend and settle such Claim. The indemnifying Party may not compromise or settle any Claim or consent to the entry of any judgment without the indemnified Party's prior written consent, provided that the indemnified Party will not unreasonably withhold or delay giving consent.

8. LIABILITY

Except for causes of action arising out of or relating to a breach of confidentiality, arising out of Client's breach of any license grant, any Party's indemnification obligations under this Agreement, or nonpayment of fees by Client, each Party's total liability to the other Party, whether in contract, tort, negligence, strict liability or by statute or otherwise, arising out of or relating to formation and performance of this Agreement including any Addenda or Work Orders, will not exceed (i) with respect to causes of action in connection with the Licensed System, and Support, the annual license fees payable to RMS in the 12 months preceding the date on which the cause of action arose, or (ii) with respect to causes of action in connection with Work, the fees payable to RMS for the Work which gave rise to the cause of action, or (iii) with respect to causes of action in connection with Hosting Services, the fees payable to RMS under the Hosting Addendum in the 12 months preceding the date on which the cause of action arose. All liability is cumulative and not per incident. This limitation will apply notwithstanding any failure of essential purpose of any limited remedy provided herein. The foregoing limitation of liability does not limit either Party's liability for any cause of action for death, bodily injury, or damage to tangible property caused by such Party's negligence. The Parties stipulate and agree that Section 9 was part of the consideration for any agreed-upon fees.

9. WAIVER OF CERTAIN DAMAGES

Except for causes of action arising out of breach of confidentiality or Client's breach of any license grant, neither Party will be liable to the other, whether in contract, tort, negligence, strict liability or by statute or otherwise, for any indirect, special, incidental, exemplary, punitive or consequential damages, damages for loss of profits, loss of business, loss of use or corruption of data or information, interruption of business or loss of anticipated savings arising out of or relating to formation and performance of this Agreement, including any Addenda and Work Orders, even if the Parties have been advised of the possibility of such damages. The Parties stipulate and agree that Section 10 was part of the consideration for any agreed-upon fees.

10. NON-SOLICITATION OF PERSONNEL

Client shall not directly or indirectly solicit for employment any employees of RMS or its affiliates during the term of this Agreement and for one year after this Agreement expires or is terminated.

11. NOTICES

All notices required under this Agreement or any Addenda or Work Orders are deemed effective when made in writing and received by: (i) registered mail, (ii) certified mail, return receipt requested, (iii) overnight mail, or (iv) electronic mail, addressed and sent to the attention of:

In the case of Client:

Name:	Fair Insurance Rates in Monroe County
Address:	442 Fleming St Room 5 Key West, Florida 33040
Email:	
Phone:	

In the case of RMS:

Name:	General Counsel
Address:	7575 Gateway Boulevard Newark, California 94560
Email:	legal@rms.com
Phone:	510-505-2500

12. EXPORT CONTROL

The Licensed System may be subject to export controls under the laws and regulations of the United States ("Export Control Laws"). Client shall comply with Export Control Laws, and without limiting the foregoing agrees that it shall not knowingly export, re-export, or transfer the Licensed System to (i) the destinations prohibited by the U.S. Bureau of Export Administration or U.S. Treasury Department's Office of Foreign Assets Control; or (ii) to any nationals or residents of any such destinations. A list of embargoed countries is available at the official web site of the Office of Foreign Assets Control of the U.S. Department of the Treasury at http://www.treas.gov/ofac/.

13. GENERAL PROVISIONS

13.1. This Agreement including any Addenda and Work Orders shall be governed by and construed under the laws of the state of New York without giving effect to any law or rule that would cause the laws of any other jurisdiction to be applied. Each Party consents to the exclusive jurisdiction of and venue in any state or federal court located in the City of New York, Borough of Manhattan, State of New York, and agrees that venue in such courts is appropriate; provided, however, that each Party consents to any jurisdiction in the State of California or New York in an action to enjoin a Party for breach of its confidentiality obligations under this Agreement.

13.2. any right or remedy hereunder, the prevailing Party shall be entitled to recover its reasonable costs and attorneys' fees.

13.3. The headings used in this Agreement or any Addenda or Work Orders are for convenience of reference only and are not to be construed in any way as material terms or be used to interpret the provisions of this Agreement or any Addenda or Work Orders.

13.4. Client shall not use the Licensed System, RMS Technology, or Work to support the development or calibration of a new or existing product or service offering which would compete with any product or service offered by RMS, whether now or in the future.

13.5. If a court of competent jurisdiction finds that any provision of this Agreement or any Addenda or Work Order is invalid or unenforceable, that provision will be enforced to the fullest extent possible in accordance with the Parties' intent as of the Effective Date, and without effect on the validity or enforceability of the remaining provisions of this Agreement or the Addendum or Work Order, which shall remain in full force and effect.

13.6. This Agreement and any Addenda and Work Orders are binding on and inures to the benefit of the Parties and their respective successors and permitted assigns. Client shall not assign or otherwise transfer its rights under this Agreement or any Addenda and Work Orders without RMS' prior written consent, which RMS will not unreasonably withhold.

13.7. The failure of either Party to enforce any right or remedy provided under this Agreement or any Addendum or Work Order shall in no way be construed to be a waiver of such rights or remedies, nor in any way affect the right of either Party to enforce each and every provision of this Agreement or any Addendum thereafter.

13.8. This Agreement or any Addenda or Work Order may be executed in one or more counterparts, each of which shall be original and all of which shall constitute one instrument.

13.9. Any modifications to this Agreement or any Addenda or Work Order must be in writing and be signed by an authorized representative of each Party.

13.10. The terms and conditions of this Agreement, and any Addenda, Work Orders, Schedules and any other attachments, constitute the entire agreement between the Parties, and supersede all previous agreements and understandings, whether oral or written, with respect to the subject matter of this Agreement.

IN WITNESS WHEREOF, the authorized representatives of the Parties have executed this Agreement as set forth below.

RISK MANAGEMENT SOLUTIONS, INC.	FAIR INSURANCE RATES IN MONROE COUNTY
Signature	Signature
Name	Name
Title	Title
Date	Date

ATTACHMENT G

RMS Wind and Surge Summary

Monroe County Whole Portfolio EP Summary

Exccedance Probability	Return Period (in years)	Aggregate Exceedance Probability (AEP)					
		Wind Only		Storm Surge Only		Wind and Coverage Leakage	
		Ground-Up Loss	Gross Loss	Ground-Up Loss	Gross Loss	Ground-Up Loss	Gross Loss
2.00%	50	$265,086,632	$208,208,313	$73,717,170	$62,181,124	$273,450,722	$214,338,494
1.00%	100	$454,715,568	$378,592,930	$139,771,943	$121,339,659	$464,897,909	$386,108,369
0.50%	200	$699,841,981	$607,796,269	$261,171,910	$229,353,346	$710,930,716	$616,212,289
0.40%	250	$809,224,335	$709,830,117	$294,222,447	$259,168,932	$821,132,365	$719,317,257
0.20%	500	$1,180,972,184	$1,067,227,983	$383,110,443	$342,325,211	$1,191,928,766	$1,076,955,150
0.10%	1,000	$1,518,835,840	$1,376,105,399	$561,299,872	$504,632,401	$1,534,292,607	$1,389,453,513
0.05%	2,000	$2,047,007,074	$1,861,521,690	$767,232,162	$699,570,004	$2,061,751,529	$1,874,376,935
0.02%	5,000	$3,236,070,183	$2,934,367,552	$985,301,090	$905,822,838	$3,258,320,897	$2,953,502,488
0.01%	10,000	$4,111,789,991	$3,590,779,417	$1,113,646,422	$1,024,765,953	$4,136,953,317	$3,611,923,177
AAL		**$24,693,820**	**$19,184,838**	**$5,689,669**	**$4,912,350**	**$25,160,163**	**$19,517,836**
Standard Deviation		**$122,002,985**	**$106,686,960**	**$40,733,741**	**$36,409,777**	**$123,533,570**	**$107,869,444**
XSAAL 250 Year		**$5,484,419**	**$4,960,246**	**$1,929,112**	**$1,730,778**	**$5,432,318**	**$5,008,963**
XSAAL 500 Year		**$3,222,617**	**$2,906,544**	**$1,177,256**	**$1,077,689**	**$3,251,160**	**$2,936,480**

Case 3: Monroe County 486 Location Subset with Secondary Modifiers EP Summary

Exccedance Probability	Return Period (in years)	Aggregate Exceedance Probability (AEP)					
		Wind Only		Storm Surge Only		Wind and Coverage Leakage	
		Ground-Up Loss	Gross Loss	Ground-Up Loss	Gross Loss	Ground-Up Loss	Gross Loss
2.00%	50	$7,650,052	$6,213,412	$2,963,348	$2,572,263	$7,941,755	$6,413,999
1.00%	100	$13,484,182	$11,264,233	$5,985,155	$5,294,853	$13,837,423	$11,527,164
0.50%	200	$21,073,727	$18,379,027	$10,360,945	$9,356,188	$21,498,765	$18,704,722
0.40%	250	$24,253,512	$21,449,468	$12,048,318	$10,837,661	$24,713,113	$21,810,398
0.20%	500	$38,802,587	$34,999,015	$17,138,906	$15,568,008	$39,261,815	$35,438,127
0.10%	1,000	$49,421,219	$45,212,706	$22,097,751	$20,125,819	$49,932,268	$45,668,533
0.05%	2,000	$63,810,381	$57,959,934	$28,577,129	$26,461,334	$64,404,702	$58,502,491
0.02%	5,000	$106,496,775	$97,931,272	$35,421,533	$32,234,729	$107,193,578	$98,421,836
0.01%	10,000	$128,967,982	$115,943,258	$43,293,517	$39,103,333	$130,148,464	$116,812,163

AAL	**$735,318**	**$571,898**	**$218,142**	**$192,408**	**$752,089**	**$584,214**
Standard Deviation	**$3,836,924**	**$3,396,893**	**$1,621,397**	**$1,463,614**	**$3,892,669**	**$3,440,618**
XSAAL 250 Year	**$164,750**	**$148,662**	**$76,192**	**$66,576**	**$166,580**	**$150,772**
XSAAL 500 Year	**$129,016**	**$116,214**	**$39,630**	**$36,215**	**$130,076**	**$118,173**

Case 2: Monroe County 486 Location Subset with FIRM Secondary Modifiers EP Summary

Exccedance Probability	Return Period (in years)	Aggregate Exceedance Probability (AEP)					
		Wind Only		Storm Surge Only		Wind and Coverage Leakage	
		Ground-Up Loss	Gross Loss	Ground-Up Loss	Gross Loss	Ground-Up Loss	Gross Loss
2.00%	50	$8,474,176	$6,943,163	$2,977,619	$2,591,047	$8,765,871	$7,150,287
1.00%	100	$14,918,586	$12,588,584	$5,965,970	$5,288,129	$15,267,490	$12,857,497
0.50%	200	$22,877,155	$20,117,547	$10,049,379	$9,091,359	$23,288,614	$20,441,301
0.40%	250	$26,311,600	$23,428,993	$11,717,942	$10,543,845	$26,755,949	$23,788,543
0.20%	500	$41,496,861	$37,557,511	$16,560,891	$15,064,872	$41,941,254	$38,004,345
0.10%	1,000	$52,315,431	$47,961,440	$21,328,206	$19,423,345	$52,804,297	$48,386,706
0.05%	2,000	$66,795,542	$60,561,827	$27,681,058	$25,605,442	$67,400,561	$61,100,912
0.02%	5,000	$108,976,481	$99,818,617	$34,308,267	$31,384,336	$109,659,033	$100,517,180
0.01%	10,000	$131,431,282	$117,049,606	$41,885,695	$37,779,242	$132,580,041	$117,855,177
AAL		**$782,555**	**$616,158**	**$216,947**	**$191,358**	**$799,415**	**$628,756**
Standard Deviation		**$4,048,748**	**$3,590,236**	**$1,576,299**	**$1,424,297**	**$4,104,328**	**$3,634,442**
XSAAL 250 Year		**$173,855**	**$157,923**	**$72,242**	**$66,320**	**$177,512**	**$161,601**
XSAAL 500 Year		**$136,226**	**$123,022**	**$38,508**	**$35,157**	**$137,192**	**$123,790**

ATTACHMENT H

FIRM Monroe County Windstorm Risk Re-Modeling and Analysis Initiative Report Costs incurred

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08/07/17
Accrual Basis

Fair Insurance Rates in Monroe
Transactions by Account
As of August 7, 2017

Exhibit H

	Date	Name	Code	Amount
Rate Study Account				
	7/19/2013	FIRM	Account Open	250.00
	7/31/2013	Harland Printing	Vulnerability Overhead	-129.59
	8/23/2013	First State Bank	Vulnerability Overhead	-10.00
	8/23/2013	Citizen's property Insurance Corp	Study Funding	485,000.00
	9/10/2013	Annalise Mannix Engineering & Consulting	Project management	-5,000.00
	10/15/2013	FIRM	Repay open Balance	-250.00
	12/20/2013	Solaria/K2M Design, Inc.	Vulnerability Study	-2,470.00
	1/28/2014	APPLIED RESEARCH ASSOCIATES, INC.	Catastropic Analysis	-8,200.00
	2/18/2014		Bank Fees	0.00
	3/21/2014	APPLIED RESEARCH ASSOCIATES, INC.	Catastropic Analysis	-29,800.00
	3/24/2014	US Postal Service	Vulnerability Study	-1,348.38
	3/25/2014	Solaria/K2M Design, Inc.	Vulnerability Study	-6,480.00
	4/15/2014	Annalise Mannix Engineering & Consulting	Project Management	-5,000.00
	4/24/2014	Solaria/K2M Design, Inc.	Vulnerability Study	-14,200.00
	5/6/2014	Solaria/K2M Design, Inc.	Vulnerability Study	-5,000.00
	8/12/2014	Solaria/K2M Design, Inc.	Vulnerability Study	-14,200.00
	9/22/2014	Annalise Mannix Engineering & Consulting	Project management	-5,000.00
	9/24/2016	Barter and Finigan	Vulnerability Study	-3,750.00
	10/1/2014	Solaria/K2M Design, Inc.	Vulnerability Study	-15,027.15
	10/9/2014	Trac Phone (additional lines for study)	Vulnerability Study	-64.48
	12/9/2014	Solaria/K2M Design, Inc.	Vulnerability Study	-29,581.00
	3/9/2015	Solaria/K2M Design, Inc.	Vulnerability Study	-109,340.00
	3/15/2015	Laura E. Burchard Inspections	Vulnerability Study	-8,704.72
	8/21/2015	Solaria/K2M Design, Inc.	Vulnerability Study	-31,195.00
	8/24/2015	APPLIED RESEARCH ASSOCIATES, INC.	Catastropic Analysis	-8,700.00
	11/19/2015	APPLIED RESEARCH ASSOCIATES, INC.	Catastropic Analysis	-17,925.00
	3/30/2016	AIS Risk Consultants, Inc.	Windstorm Risk	-7,500.00
	5/5/2016	APPLIED RESEARCH ASSOCIATES, INC.	Catastropic Analysis	-15,075.00
	6/30/2016	Fair Insurance Rates Monroe	Vulnerability Study	-402.75
	7/20/2016	Risk Management Solutions	Catastropic Analysis	-90,052.50

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08/07/17
Accrual Basis

Fair Insurance Rates in Monroe
Transactions by Account
As of August 7, 2017

Date	Name	Code	Amount
8/8/2016	AIS Risk Consultants, Inc.	Windstorm Risk	-10,500.00
8/8/2016	AIS Risk Consultants, Inc.	Windstorm Risk	-7,000.00
9/1/2016	APPLIED RESEARCH ASSOCIATES, INC.	Catastrophic Analysis	-4,800.00
7/10/2017	Report Production	Vulnerability Study	-650.00
7/18/2017	Engineering and Consulting	Project management	-5,000.00
8/3/2017	Market Analysis exploration of alternate options	Natural Catastrophic Analysis	-25,500.00
			-2,605.57
	TOTAL		-2,605.57

Expense by category

Vulnerability Study	$	242,553.07
Windstorm Risk	$	25,000.00
Natural Catastrophic Analysis	$	200,052.50
Project Management	$	20,000.00
Total	$	487,605.57