

Investigation of the Wind-borne Debris Regions in ASCE 7-22

Florida Department of Business and Professional Regulation
Florida Building Commission

and

Engineering School of Sustainable Infrastructure and Environment (ESSIE)
University of Florida (UF)

Project Leader: Jennifer A. Bridge, Ph.D., University of Florida

1. Introduction

Removing the word “coastal” from the definition of a wind-borne debris region (WBDR) in American Society of Civil Engineers (ASCE) 7-22 results in some inland regions meeting the new definition. This change, adopted in the 8th edition of the Florida Building Code, creates inland WBDR regions in Florida for areas that are adjacent to lakes that have at least 5,000 ft of fetch and design wind speeds between 130 and 140 mph; design wind speeds above 140 mph in hurricane prone regions are designated WBDR regardless of adjacent water bodies.

The objective of this study is to provide the Florida Building Commission a science-based analysis on the appropriateness of inland regions being designated as WBDRs that require increased protection for buildings. In particular, the study will seek to evaluate the differences between coastal and inland WBDRs across a number of contributing factors (e.g. exposure, land coverage, and development trends). The objectives will be achieved through an investigation into the origin of the language change (i.e. the removal of the requirement for the region to be coastal) in ASCE 7-22, a review of all relevant literature related to the designation of WBDRs, a comprehensive evaluation of available damage assessments conducted in the coastal and proposed inland WBDRs, and an analysis of debris generating potential and building damage vulnerability in the proposed regions through modeling and aerial imagery analysis. In addition, this study will conduct a cost analysis to estimate the difference in cost of construction to meet the design requirements for WBDRs. The short timeframe available for this study is likely to raise many questions that may not have adequate time to be resolved. As a result, this study should be considered an initial, limited effort that would benefit from follow-up research. The study will be led by University of Florida researchers in the Engineering School of Sustainable Infrastructure and Environment (UF ESSIE), M.E. Rinker, Sr. School of Construction Management (UF Rinker), and will be supported by Applied Research Associates (ARA).

2. Scope of work

Task 1: Background and Literature Review

- a. UF ESSIE shall meet with ASCE 7 parties involved in the language change to the WBDR definitions, including the wind load subcommittee chair, balloter, and historian to document how definitions for WBDR were developed.

- b. UF ESSIE shall review ASCE 7 prior editions and describe the intent of the original designation for the WBDR definition.
- c. UF ESSIE shall conduct a review of relevant literature related to the designation of WBDRs, including ARA study on the windborne debris risk for the Panhandle.
- d. UF ESSIE shall provide a summary of the literature review outlining the recommendations and conclusions of each research study reviewed.
- e. UF ESSIE shall determine whether literature is conclusive to either support or refute the ASCE 7-22 wind loads subcommittee WBDR definition change.

Task 2: Data Acquisition and Analysis

- a. The objective of Task 2 is to ascertain from existing data, where available (e.g. damage assessments and MAT reports in coastal and inland WBDRs) the influence of the presence of open waters impacts on the wind-borne debris damaged and to conduct field investigations of designated areas along the coast and along in inland areas.
- b. UF ESSIE shall evaluate from prior hurricane reconnaissance documents, where available, the extent of building damage from wind-borne debris to structures adjacent to inland waterways.
- c. UF ESSIE shall compare the existing building, development, and land coverage conditions for select inland lake regions and coastal regions using aerial imagery and other existing data sources to characterize typical missile sources and building densities. This data will also be used to support modeling efforts by ARA as outlined in Task 3.

Task 3: Modelling

- a. The objective of Task 3 is to perform simulations to answer the following questions:
 - o What is the increased WBD risk for areas near inland waterways that create exposure D conditions?
 - o Over what distance from these lakes is the increased risk observed?
- b. ARA will use their HurMis software and existing neighborhood models to perform these simulations. The methodology will be updated to account for changes in surface roughness with distance from inland water locations (i.e., exposure D conditions). This will enable comparison of WBD risk in areas adjacent to and far from large inland lakes.
- c. ARA shall use land coverage analysis provided by UF ESSIE in Task 2 to assess the applicability of the existing neighborhood models used in the analysis and to corroborate the change in surface roughness with distance from the water.

Task 4: Cost Benefit Analysis

- a. The objective of Task 4 is to establish the cost difference between housing construction in the same geographical regions with and without the code prescribed design requirements for housing build in WBDRs.
- b. UF Rinker shall evaluate the costs to meet the design requirements for WBDRs in the 8th ed. FBC/ASCE 7-22 (e.g. impact resistant glazing or protective coverings). This evaluation will be based on current market costs and consultations with home builder representatives.

- c. UF Rinker will use established BIM models for a number of single-family home construction types to calculate the percent increase in costs to meet WBDR requirements for the same building types in the same regions. The difference may be presented as a difference per square foot or per linear foot of building envelope. The building designs used for cost analysis (both with and without WBDR requirements) will be validated for compliance with design code with input from a designer and/or relevant homebuilder associations.
- d. UF Rinker and ESSIE will evaluate previous studies (e.g. ARA 2008 Florida Residential Wind Loss Mitigation Study for the Florida Office of Insurance Regulation) to report a range of quantitative benefits to opening protection measures required for WBDRs.

Task 5: Reporting and Recommendations

- a. UF ESSIE and ARA shall develop figures, which may include maps, based on study results to visualize the findings and support decision making regarding Florida Building Code WBDRs.
- b. UF ESSIE shall provide preliminary recommendations for modifications to the Florida Building Code to incorporate results of the proposed study into the FBC.

3. Staffing

PI: Jennifer Bridge, Ph.D., Associate Professor, Engineering School for Sustainable Infrastructure and Environment, University of Florida

Co-PI: David Prevatt, Ph.D. P.E., Professor, Engineering School for Sustainable Infrastructure and Environment, University of Florida

Co-PI: Kurtis Gurley, Professor, Engineering School for Sustainable Infrastructure and Environment, University of Florida

Co-PI: Raymond Issa, Professor, M.E. Rinker, Sr. School of Construction Management, University of Florida

Co-PI: Jeffrey C. Sciaudone, P.E., Applied Research Associates (subcontractor)

4. Method of Payment

A purchase order will be issued to the University of Florida. This project shall start on date of execution of the purchase order and end at the midnight on June 30, 2025. This purchase order shall not exceed \$250,000.00 and shall cover all costs for labor, materials and overhead. Payment will be made for the study after the Program Manager and the Florida Building Commission's Hurricane Research Advisory Committee have approved the final report. Additionally, the Contractor agrees to provide additional documentation requested by the Program Manager to satisfy all payment and audit requirements.

5. Deliverables

- a. An interim report shall be prepared and delivered no later than December 15, 2024. The interim report shall summarize the findings of the study and provide specific recommendations for code modifications that are necessary to incorporate results of the proposed study into the Florida Building Code. In addition, the interim report shall cover progress to date on all tasks, preliminary results, and descriptions of any issues that may have been encountered. The interim report shall be formally presented to the Florida Building Commission's Hurricane Research Advisory Committee at a time agreed to by the Contractor and Department's Program Manager. The due date may be extended with the approval of the Department's Program Manager.
- b. A draft final report shall be prepared and delivered no later than May 15, 2025, for comments by the Florida Building Commission's Hurricane Research Advisory Committee. The report shall contain deliverables of the five tasks discussed in Section 2. This shall include a summary of the literature review, summary and analysis of data acquisition, summary of the background investigation regarding the definition of the WBDR, summary of the cost-benefit analysis, and specific recommendations for code modifications that are necessary to incorporate results of the proposed study into the Florida Building Code. The final report shall be prepared with revisions to address Hurricane Research Advisory Committee comments and delivered no later than June 15, 2025. In addition, the draft final report and the final report shall be formally presented to the Hurricane Research Advisory Committee at a time agreed to by the Contractor and Department's Program Manager. The due date may be extended with the approval of the Department's Program Manager.

6. Financial Consequences

UF ESSIE is solely responsible for the satisfactory performance of the tasks and completion of the deliverables as described in this Scope of Work. Failure to complete the tasks and deliverables in the time and manner specified in Sections 2 and 5 shall result in a non-payment of invoice until corrective action is completed as prescribed by the program or contract manager.

7. Program Manager

The Program Manager for this project is Mo Madani. Mo Madani's email address is Mo.Madani@myfloridalicense.com and his phone number is 850-717-1825.