

# Charting Solutions in a Resilient City 2.0, Tidewater, Virginia

Portsmouth, NH  
May 7-9, 2023



# SESSION SPEAKERS



## KERRY SHACKELFORD

- Class A Contractor & Principal, Museum Resources Construction and Millwork
- Co-owner, Building Resilient Solutions (BRS)



## PAIGE POLLARD

- Principal, Commonwealth Preservation Group
- Co-owner, Building Resilient Solutions (BRS)





# ABOUT BUILDING RESILIENT SOLUTIONS (BRS)



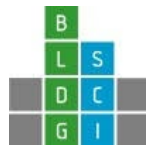
- Location: Suffolk, Virginia
- First lab of its kind
- Support testing alternative retrofits
- Yields thoughtful, informed solutions



# OUR WORK: 2021

## Addressed issues with current codes and ordinances

- Indiscriminate impact on properties
  - Trigger not limited to flood related events
- Loss of inherently resilient historic building materials
  - Enter permanent cycle of replacement with disposable materials
- Reduction in property values
  - Impact to real estate assessment
- No solutions for properties when elevation and demolition are too extreme given the risk







# OUR WORK: 2022

## Opening of our Suffolk Lab

### Initial Testing Objectives

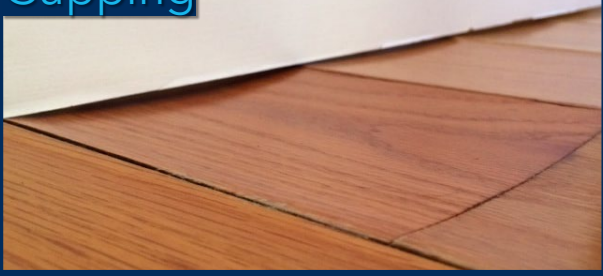
- Development of consistent assessment method durability and reuse of materials post flood event
- Establishment of damage functions for future occurrences of flooding events
- Creation of baseline for an empirical approach to develop fragility curves



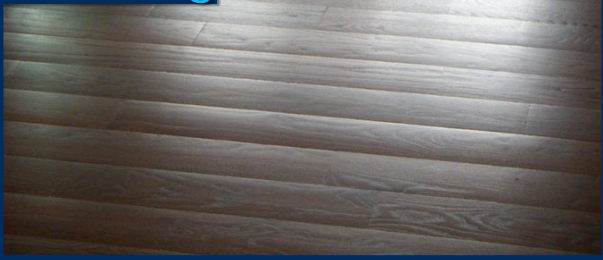


# TEST PROTOCOL 1.1 PURPOSE & PARTNERS

Cupping



Crowning



Buckling



Cracking



## Goal

*Study the durability and survivability of historic wood flooring materials that have been exposed to limited duration water inundation, as is commonly experienced during tidal flooding events*

## Test Partners:





# TEST PROTOCOL 1.1 DESIGN



## How? The Flood Chamber

- Can be flooded to simulate flood event
- Drained after set period of time to replicate a drying period

## Data Collected

Changes occurring in wood samples:

- Width
- Thickness
- Weight
- Moisture Content





# TEST PROTOCOL 1.1 DESIGN

## Materials Tested

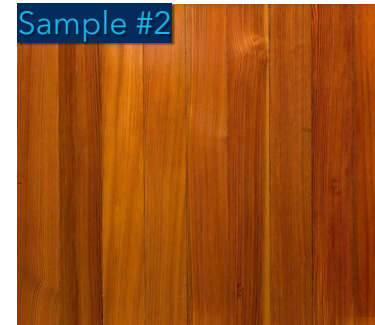
Flooring samples representative of common flooring materials in Tidewater, VA

- Pre-1970s structures
- Modern structures

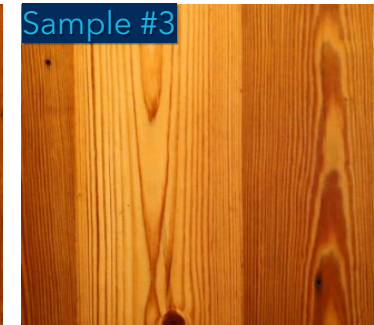
Sample #1



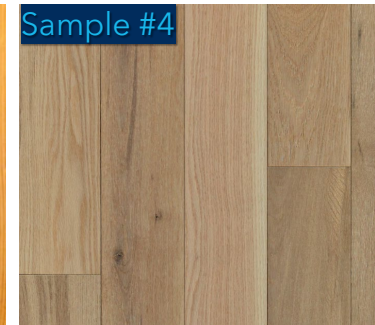
Sample #2



Sample #3

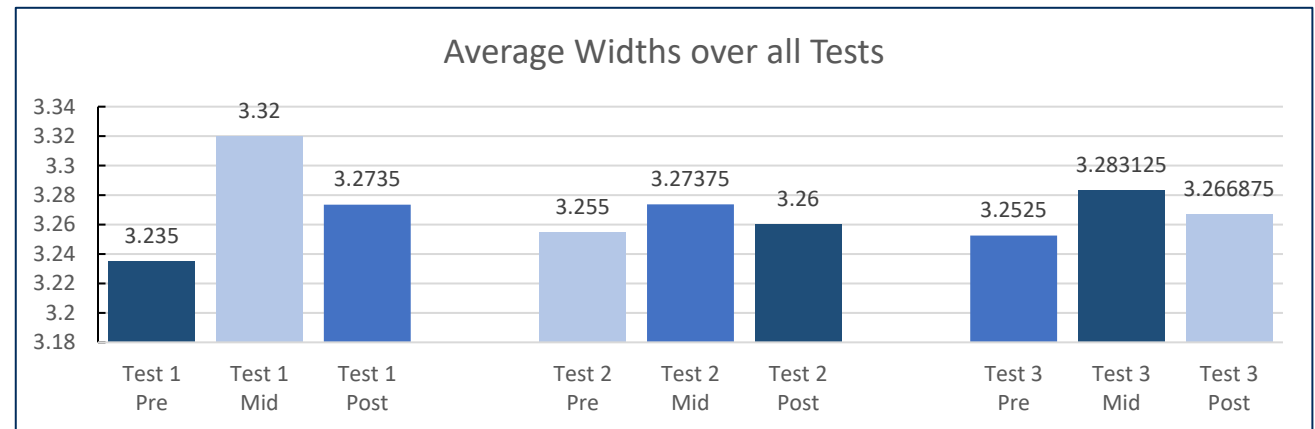
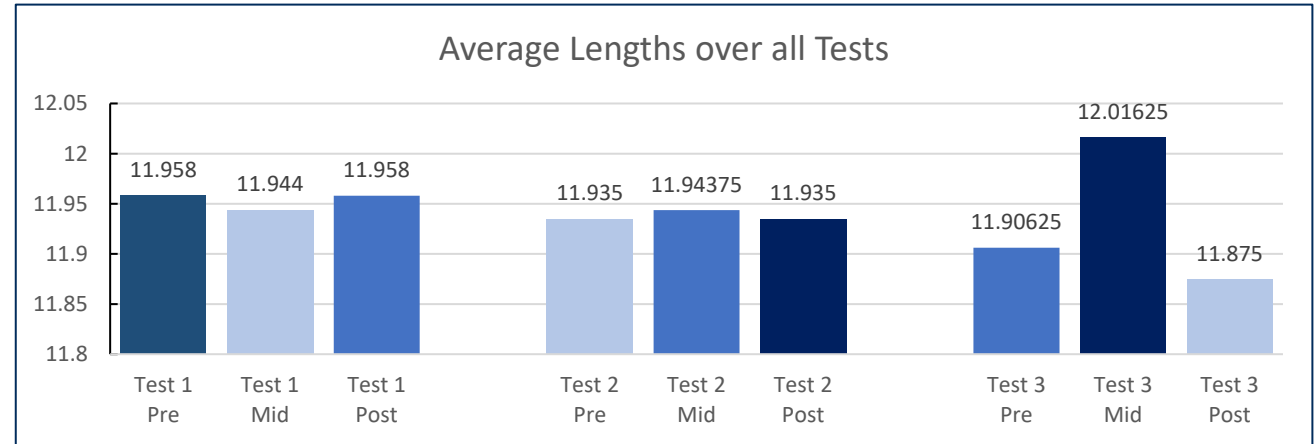


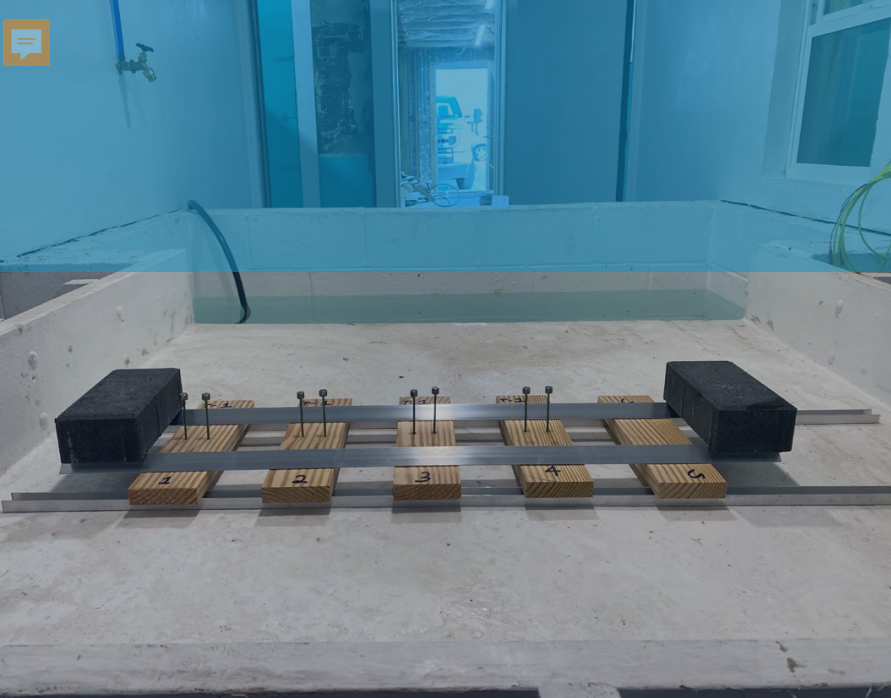
Sample #4





# TEST PROTOCOL 1.1 DATA





# TEST PROTOCOL 1.1 TAKEAWAYS

Executive Summary Test 1.1

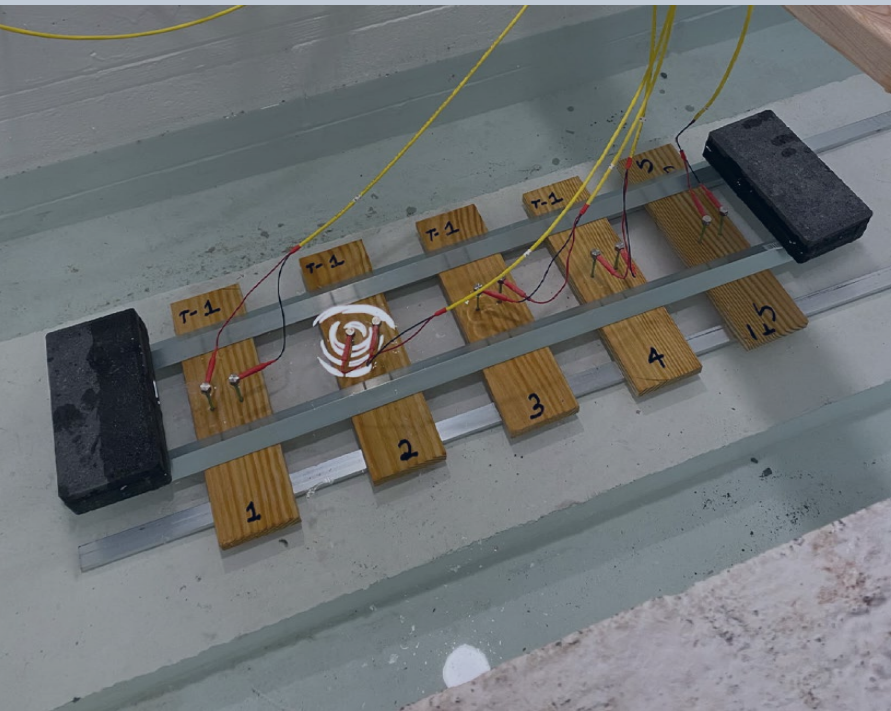


## Conclusions

- Modern growth had little dimensional stability
- Wood commonly found in floors in pre-1970 structures generally outperformed modern low-to-moderate wood used in modern flooring

## Final Takeaway

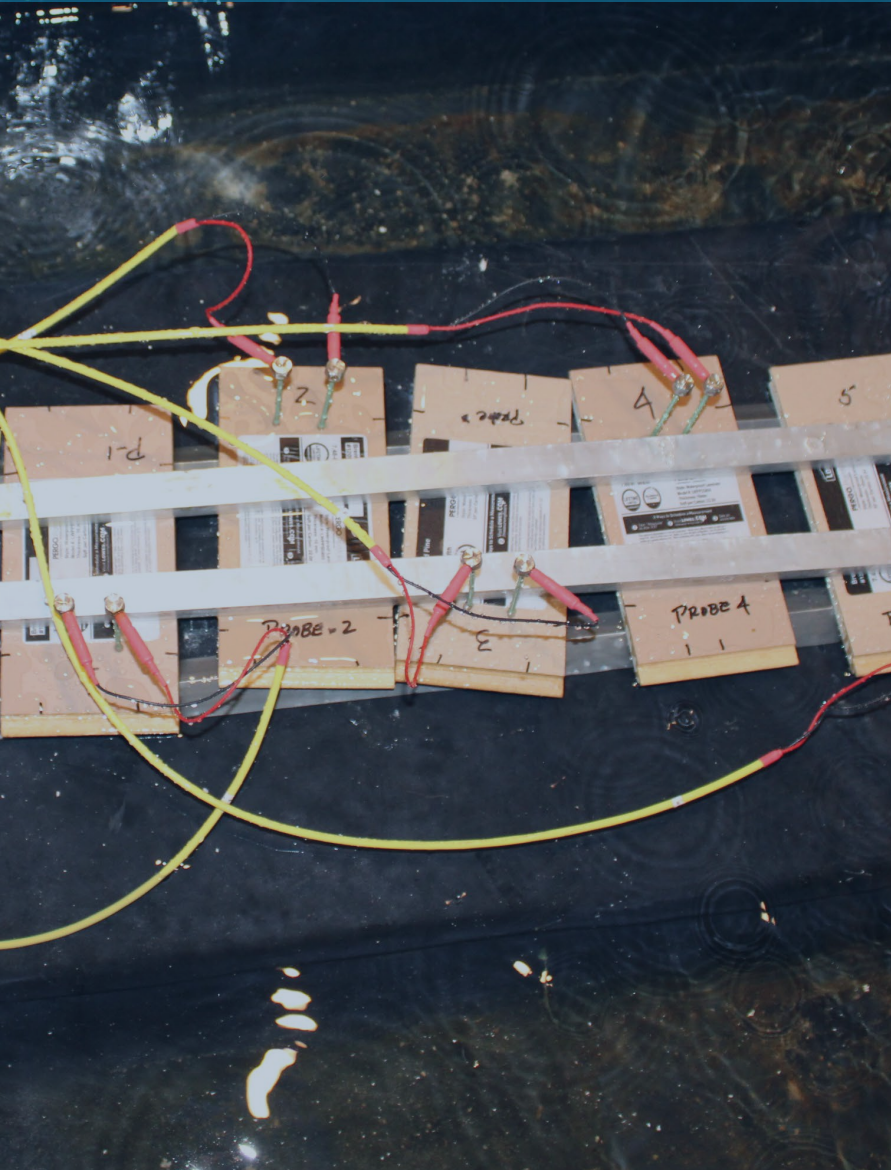
Future protocol should be developed to test post-storm recovery for flooring





# TEST PROTOCOL 1.2

## PURPOSE AND PARTNERS



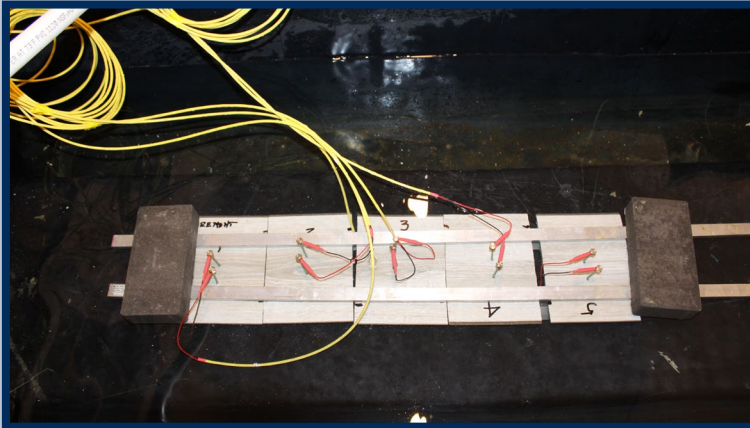
### Goal

*Study the flood resilience of engineered wood flooring materials specifically designed to survive minor flooding events*

### Test Partners:



# TEST PROTOCOL 1.2 DESIGN



## How? The Flood Chamber

### Same conditions used for Protocol 1.1

- Made to replicate a flood event
- Drained after set period of time to replicate a drying period

## Data collected

### Changes occurring in samples:

- Size
- Deformations
- Moisture retention
- Appearance
- Will be compared to historic flooring



Reichard  
BUILDING SCIENCE  
Consulting, LLC



# TEST PROTOCOL 1.2 DESIGN



## Materials Tested

Engineered wood flooring materials from three major retailers:

- Pergo Wet-Protect Brentwood Pine Wood Plank Laminate Flooring
- Freemont Eco Resilient Flooring
- Midtown Light Oak Wire-Brushed Engineered Hardwood

Material #1



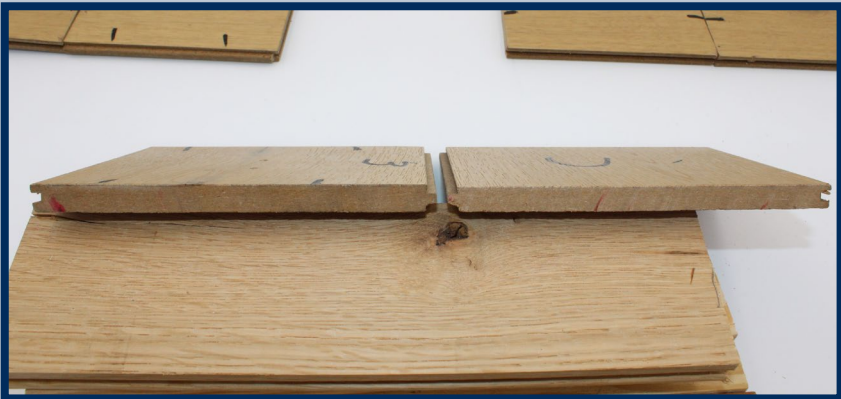
Material #2



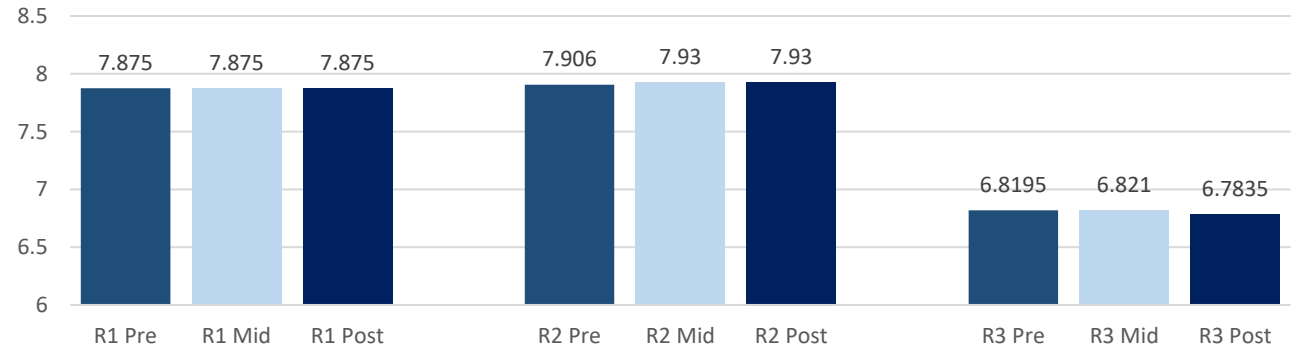
Material #3



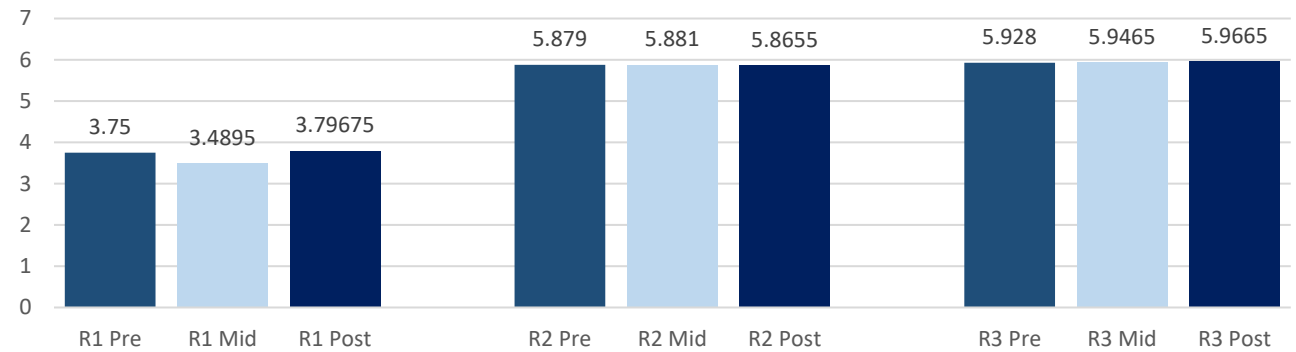
# TEST PROTOCOL 1.2 DATA



Comparison of Average Length from all Rounds



Comparison of Average Width from all Rounds





# TEST PROTOCOL 1.2

## Takeaways



### Conclusions

- All engineered flooring tested exhibited dimensional instability: Samples cupped and distorted in thickness and width
- Engineered products with no wood in their composition were the most resilient of the group  
While moderately resistant to moisture the engineer products can not be repaired post flooding
- While moderately resistant to moisture, the engineered products cannot be repaired post flood event

### Final Takeaway

Future testing should also include a complete floor assembly including glue down applications and nail applications



# TEST PROTOCOL 2.1

## PURPOSE and PARTNERS



### Goal

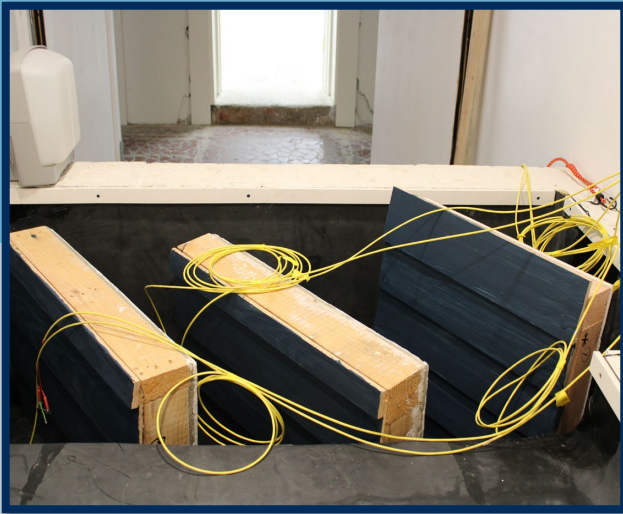
*Study the survivability of historic plaster wall assemblies and exterior cladding materials that have been exposed to limited duration water inundation, as is commonly experienced during tidal flooding events*

### Test Partners:





# TEST PROTOCOL 2.1 DESIGN



## How? The Flood Chamber

- Made to replicate a flood event
- Can be flooded to simulate flood event
- Drained after set period of time to replicate a drying period

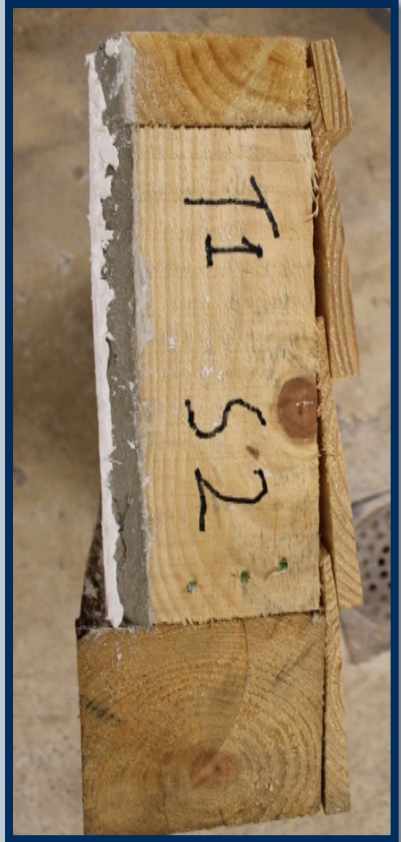
## Data collected

### Changes occurring in samples:

- Moisture content
- General observations



# TEST PROTOCOL 2.1 DESIGN



## Materials Tested

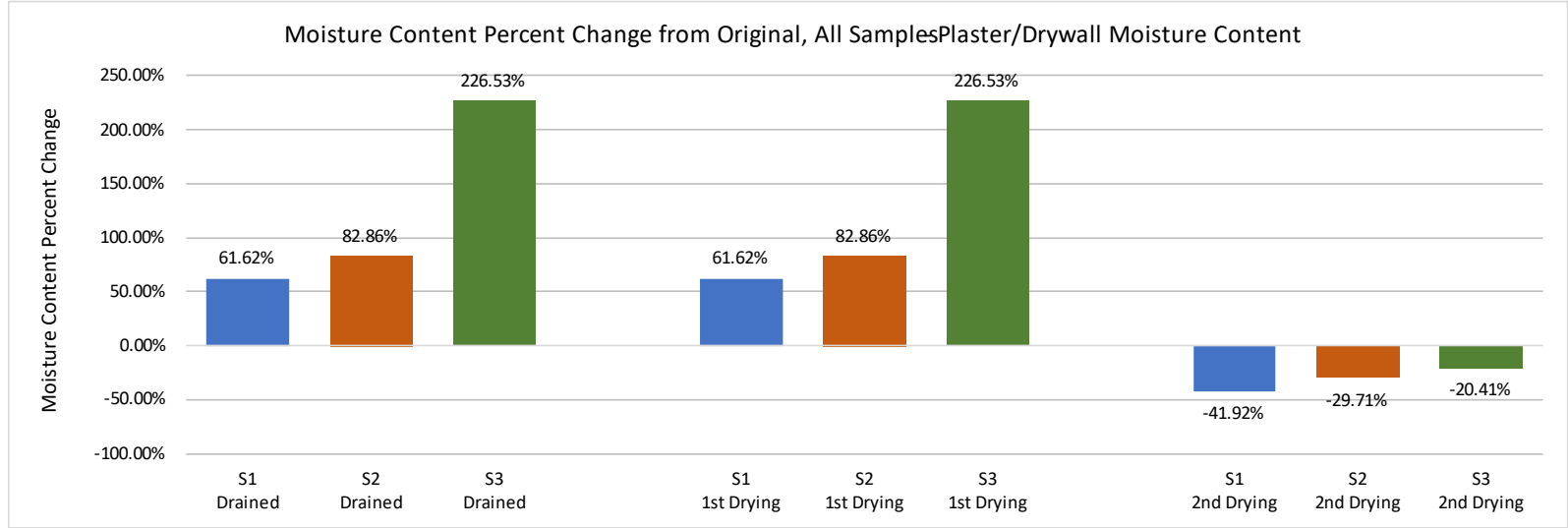
Replicated assemblies representative of common assemblies in Tidewater, VA

Samples that were used include:

- Plaster on Wood Lath with taper sawn Southern Yellow Pine Siding
- Plaster on Wire Lath with taper sawn Southern Yellow Pine Siding
- Modern Drywall with taper sawn Southern Yellow Pine Siding



# TEST PROTOCOL 2.1 DATA





# TEST PROTOCOL 2.1

## Takeaways

Executive Summary Test 2.1



### Conclusions

- Common wall assemblies in pre-1970 structures are highly survivable in flood scenarios.
- Plaster on wood or wire lath wall assembly are highly survivable in flood events

### Final Takeaway

Future protocol should be developed to test post-storm recovery of wall assemblies





# OUR WORK: 722 FILER STREET

Before



After



## Background

c.1920s residence

- 1,082 SF
- 1.5 Stories

Chesterfield Heights Historic District

Family purchased 1964; first flood incident 2009

Project completed April 2023

# OUR WORK: 722 FILER STREET



## Project Scope

- Owner to “age in place” with ADA mobility and care considerations for parent
- Involved Flood Mitigation and Retrofit
- Use of Moisture monitoring and Building Assessment
- Received a Special Flood Hazard Area Exception Approval from Norfolk's Floodplain Ordinance



# OUR WORK: 722 FILER STREET

Before



After



- Regrade site
- Reinstate pier foundation and flooring system
- Install properly functioning gutters and downspouts
- Apply mold and rot resistant materials up to the DFE

During Construction



# OUR WORK: 722 FILER STREET

After



- Reconfigure floorplan
- Use of rot resistant materials
  - Fibrex board drywall below Design Flood Elevation with a 3" gap Above Finished Floor
  - Rot resistant framing and trim
- Historic/heart pine replacement flooring
- Electrical run in weathertight conduit polystyrene insulation
- Capillary break at the chair rail
- Slot at top for ventilation behind crown (in addition to base)



# FUTURE TESTING PRIORITIES

- Complete flooring assembly
- Systems with subfloor
- Systems without subfloor
- Nailed in place flooring
- Glued in place flooring
- Post flood event use of materials
- Biological contaminants
- Local flood waters





# DISCUSSION



WHAT FUTURE TESTING  
WOULD YOU LIKE TO SEE?



# RESOURCES AND PARTNERS



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**BUILDING RESILIENT SOLUTIONS**

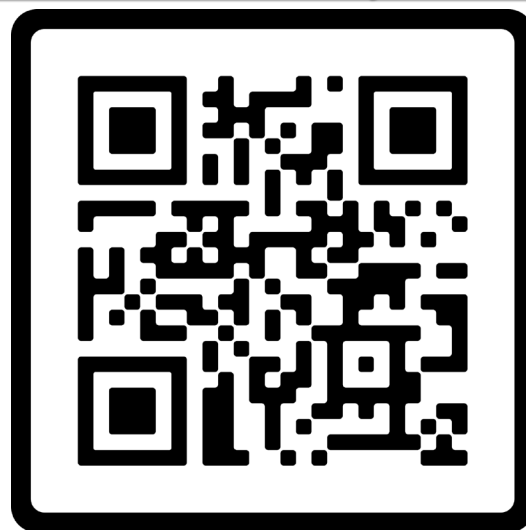
Thoughtful, informed retrofit design.

Email: [admin@brs.llc](mailto:admin@brs.llc)

Website: <https://www.brs.llc/>

# EXECUTIVE SUMMARIES

Executive Summary Test 1.1



Executive Summary Test 2.1

