Strategic Property Buyouts To Enhance Flood Resilience

Creating a Model for Flood Risk Reduction, Community Protection and Environmental Gains

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Hurricane Harvey inundated hundreds of thousands of homes with an estimated damage of USD 125 billion.

Damages to some of these properties could have been prevented if they were previously identified as having important natural values and bought-out or acquired prior to the flood event.

Existing land acquisition and buyout programs are often initiated in a reactionary manner after a flooding event has occurred, resulting in open spaces that does little to protect environmental assets or prevent long term flooding for structures in vulnerable locations.
This study addresses the problem by developing a proactive framework for identifying candidate parcels for acquisition in advance of storm events by prioritizing important natural features.

This approach enables the selection of properties with the potential of being restored to open spaces as well as serve important natural flood attenuation purposes.
Existing Buyouts in Harris County

Harris County Buyouts Summary since 1997

- Total number of buyouts: 3,100
- Amount spent by Federal grants: $150 million
- Amount spent Local and State grants: $190 million
- Total Acres restored to floodplain: 1,060
- Avoided Damages and ROE from Hurricane Harvey: $300 million, ROE 1.61
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Avoided Damages and ROE:
- $300 million
- ROE 1.61

Source: ProPublica & Harris County Flood Control District

COE: Army Corp of Engineers
HGMP: Hazard Mitigation Grant Program
District: Harris County Flood Control District
FMA: Flood Mitigation Assistance
TSA: Transitional Sheltering Assistance
PDM: Pre-Disaster Mitigation Grant Program
Some Shortfalls

- Priority is given to structures deep within the 100-yr floodplain.
- Only Structures with repetitive flood damages usually determined from insured flood claims are considered.
- Properties outside the floodplain and in proximity to important ecological services are not considered.
- Poor consideration for proximity to existing buyouts.

Source: Harris County Flood Control District
We begin with all properties inundated by Hurricane Harvey with significant damage to both structure and contents of the building.

We measure distance to various natural features from the affected property:

- **Floodplain**
- **Wetland**
- **Protected Areas**
- **Parks**
- **Existing Buyouts**

We also prioritize properties with repetitive flood claims.

* We prioritize properties in census tracts with a SVI score of $\geq 0.5$ determined from CDC social vulnerability database.

Properties that meet the eligibility criteria for different scenario are selected as candidates for future buyouts and property acquisition.
Flood Damage Modeling:

NFIP Flood claim Payment for Harvey?

Yes

Depth of flood from Harvey

Structural Characteristics of Building
- Improvement Value
- Foundation Height
- Foundation type
- Number of Stories
- Exterior Material
- Building Square footage
- Building Occupancy type

USACE Depth Damage Function

Estimate of Damages from Harvey

No

Estimate Building + Content Loss

Harvey Damages
Benefit - Cost Calculation

Total Flood Loss (Harvey and Historic Flood Claims)  
___________________  
Assessed Market Value of Property  

We assume that a ratio higher than 1 indicates that the scenario would have a net financial benefit to the community.
## Buyout Selection Scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Measures</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Practice</strong></td>
<td>Flooding Source</td>
<td>Riverine flooding</td>
</tr>
<tr>
<td></td>
<td>Repetitive Loss</td>
<td>Whether property loss is repetitive</td>
</tr>
<tr>
<td></td>
<td>Floodplain</td>
<td>Whether property is in the floodplain</td>
</tr>
<tr>
<td><strong>Wetlands, Floodplains and Buyouts</strong></td>
<td>SFHA distance</td>
<td>Distance of property to edge of floodplain</td>
</tr>
<tr>
<td></td>
<td>NWI Distance</td>
<td>Distance of property to edge of Wetland</td>
</tr>
<tr>
<td></td>
<td>Buyout Distance</td>
<td>Distance of property to nearest existing buyout</td>
</tr>
<tr>
<td><strong>Parks, Protected Areas, and Buyouts</strong></td>
<td>Park distance</td>
<td>Distance of property to parks</td>
</tr>
<tr>
<td></td>
<td>Conservation</td>
<td>Distance of property to conservation east.</td>
</tr>
<tr>
<td></td>
<td>Protected Areas</td>
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<td>Distance of property to nearest existing buyout</td>
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<tr>
<td><strong>All Natural Features and Buyouts</strong></td>
<td>SFHA distance</td>
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</table>
Business as usual: Existing Requirements in Harris County

Selection Criteria
- Property in Floodplain? ✓
- Repetitive Flood Loss? ✓
- Riverine Flooding Event? ✓
- Distance to Existing Buyouts? ❌

Result
- Total number of candidate buyouts: 362
- Total Damages from Harvey and other floods: $113 million
- Market Value of Properties: $42 million

- Damages - Market Value Ratio: 2.67
- Total Acres restored to ecological: 117

Selection Criteria:
- No of Properties: 362
- Harvey Damages ($ million): 57.56
- Rep Claims ($ million): 56.21
- Harvey + Rep Loss ($ million): 113.77
- Market Value ($ million): 42.69
- Damage-Market value ratio: 2.67
- Avg dist to Buyouts (ft): 6,375.34
- Avg dist to Parks (ft): 1,862.27
- Avg dist to SFHA (ft): 0
- Avg dist to Wetlands (ft): 472.74
- Avg dist to Protected areas (ft): 2,408.27
- Total acreage restored: 117.47

Legend:
- Existing Buyouts
- Candidate Buyouts
- Floodplains and Protected Areas
Business as Usual: Existing Requirements in Harris County: Example Area

Some candidate buyouts in proximity to existing buyouts

Only few eligible parcels despite location within the floodplain

Not Eligible
Outside the floodplain

Result

Total number of candidate buyouts: 362
Total damage from 100-yr flood: $113 million
Market Value of Properties: $42 million

Damage/Market Value Ratio: 2.67
Total damages not exceed market: 117
Selection Criteria

- Existing Buyouts Distance
- Park Distance ≤ 1000 ft
- Wetland Distance ≤ 1000 ft
- Protected Area Distance ≤ 1000 ft
- Floodplain Distance ≤ 1000 ft

Result

- Total number of candidate buyouts: 290
- Total Damages from Harvey and other floods: $44 million
- Total Damages from Harvey and other floods: $44 million
- Total Market Value of Properties: $24 million

No of Properties: 290
Harvey Damages ($ million): 36.9
Repetitive claims ($ million): 7.13
Harvey + Rep Loss ($ million): 44.03
Market Value ($ million): 24.39
Damage-Market value ratio: 1.81
Avg dist to Buyouts (ft): 351.62
Avg dist to Parks (ft): 555.70
Avg dist to SFHA (ft): 65.50
Avg dist to Wetlands (ft): 450.73
Avg dist to Protected areas (ft): 561.44
Total acres restored: 67.05

Legend
- Existing Buyouts
- Candidate Buyouts
- Floodplains and Protected Areas
Candidate buyouts are located near natural features and existing buyouts.
4b: All Natural Features, Buyouts and Social vulnerability

Selection Criteria

- Existing Buyouts Distance
- Park Distance ≤ 1000 ft
- Wetland Distance ≤ 1000 ft
- Protected Area Distance ≤ 1000 ft
- Floodplain Distance ≤ 1000 ft
- Social Vulnerability > 0.5

Result

- Total number of candidate buyouts: 192
- Total Damages from Harvey and other floods: $30 million
- Market Value of Properties: $14 million
- Damages–Market Value Ratio: 2.12
- Total Acres restored to ecological: 38

<table>
<thead>
<tr>
<th>Property Feature</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Harvey Damages ($ million)</td>
<td>23.68</td>
</tr>
<tr>
<td>Repetitive claims ($ million)</td>
<td>6.27</td>
</tr>
<tr>
<td>Harvey +Rep Loss ($ million)</td>
<td>29.95</td>
</tr>
<tr>
<td>Market Value ($ million)</td>
<td>14.16</td>
</tr>
<tr>
<td>Damage-Market value ratio</td>
<td>2.12</td>
</tr>
<tr>
<td>Avg dist to Buyouts (ft)</td>
<td>338.35</td>
</tr>
<tr>
<td>Avg dist to Parks (ft)</td>
<td>550.98</td>
</tr>
<tr>
<td>Avg dist to SFHA (ft)</td>
<td>57.92</td>
</tr>
<tr>
<td>Avg dist to Wetlands (ft)</td>
<td>481.92</td>
</tr>
<tr>
<td>Avg dist to Protected areas (ft)</td>
<td>547.80</td>
</tr>
<tr>
<td>Total acreage restored</td>
<td>38.78</td>
</tr>
</tbody>
</table>
4b: All Ecological Features, Buyouts and social vulnerability (1000 ft): Example Area

Proximity to all ecological features including existing buyouts and high Housing and Transportation Social Vulnerability
4b: All Ecological Features and Buyouts (1000 ft): Example Area
Results

Economic Benefits from Candidate Buyout Scenarios

Damage-Market Value Ratio

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<thead>
<tr>
<th>Scenario</th>
<th>Damage-Market Value Ratio</th>
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<tbody>
<tr>
<td>Current Practice</td>
<td>2.67, 2.58</td>
</tr>
<tr>
<td>SFHA, Wetlands</td>
<td>1.79, 1.62</td>
</tr>
<tr>
<td>Parks, Protected areas</td>
<td>1.69, 1.45, 1.76, 1.51</td>
</tr>
<tr>
<td>All Natural features</td>
<td>1.69, 1.81, 2.12</td>
</tr>
</tbody>
</table>

Damage vs Market Value Ratio
Summary

The proactive model prioritizes clustered buyouts that are close to natural features and ultimately can result in fewer, larger patches of open space that can be restored to benefit people and nature.
Benefits of Strategic Buyouts

- Over time, can lead to clusters of open space that can be used as green infrastructure to restore the functions of floodplains, absorb and clean storm water, provide space for outdoor recreation and improve the visual character of urban areas.
- As cost effective as traditional buyouts.

- Less expensive to manage fewer, larger areas with multiple functions rather than scattered, empty lots.
- Added benefits for people and wildlife.
Benefits of Strategic Buyouts

From 1992-2010, Houston lost wetlands that could detain 4 billion gallons of storm water ($600 million in lost storm water detention).

- The $2.5b flood bond passed on Harvey’s anniversary in August included funding for both traditional infrastructure repair as well as taking a look at things like detention ponds restoration.

- Research shows that every square meter of Houston pavement equates to $4,000 in extra flood damage. (Sam Brody/TAMU)
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