# Assessing the Full Costs of Floodplain Buyouts

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## Abstract

Given projected increases in flood damages, managed retreat strategies are likely to become more widespread. Voluntary buyouts, where governments acquire flood-damaged properties and return the sites to open space, have been the primary form of federally-funded retreat in the U.S. to date. However, little attention has been paid to the cost structure of buyout projects. Using a transaction cost framework, we analyze the costs of activities that comprise floodplain buyouts. Federal data do not distinguish transaction costs, but they do suggest that the cost of purchasing properties often accounts for 80% or less of total project costs. Through a systematic review (n = 1,103 publications) and an analysis of government budgets (across n = 859 jurisdiction-years), we find limited sources with relevant cost information, none of which report transaction costs. The absence of activity-level cost data inhibits more

targeted policy reform to support community-driven and efficient buyout programs. More detailed data collection and reporting can inform more impactful and equitable buyout policy.

## Declarations


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### Conflicts of interest/Competing interests

The authors have no conflicts of interest to declare.

### Availability of data and material

Data will be available via UNC dataverse: https://dataverse.unc.edu/

### Code availability

Code will be available via UNC dataverse: https://dataverse.unc.edu/

### Authors' contributions

W.C.-G.: lead manuscript writing and literature review; H.H led budget review and assisted in writing manuscript; M.H. assisted in writing and editing manuscript; T.K.B. and D.S. assisted in writing and editing manuscript and gained project funding.

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Not applicable

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Not applicable

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Not applicable

# Assessing the Full Costs of Floodplain Buyouts

## 1. Introduction

Average annual, flood-related damages in the U.S. have increased significantly over time (Davenport et al. 2021). This trend, combined with population growth patterns and a variety of negative predicted effects of climate change (Wing et al. 2018), has contributed to a growing consensus that managed retreat will be a necessary component of flood mitigation strategies going forward (Reidmiller et al. 2018). To date, *floodplain buyouts*[1] have constituted the primary federally-funded approach to managed retreat in the U.S. (Dyckman et al. 2014). In buyout programs, governments purchase flood-prone properties from willing sellers, usually restoring the land to some sort of open space. Property owners receive compensation for their flood-damaged homes, while the removal of structures from the floodplain reduces future flood damages and emergency response burdens (BenDor et al. 2020; Siders 2013a).

Efforts to assess and improve floodplain buyouts require an understanding of their full costs across the different levels of government involved, as is true of other devolved funding structures (Feiock 2001). While both federal agencies (e.g., FEMA 2013; FEMA 2021a) and academic researchers (e.g., Tate et al. 2016; Nelson and Camp 2020) have undertaken benefit-cost studies, these studies often conflate property purchase costs with total project costs, omit certain cost categories, or overlook the distribution of costs among actors. These data gaps are problematic for several reasons. First, non-purchase costs associated with buyouts may be large due to the information-sharing, planning, and negotiation involved (Meyer et

[1] We use the term "buyout" throughout this paper to refer both to acquisition projects where property owners are offered pre-flood fair market values (FMV) and acquisition projects where property owners are offered post-flood FMVs. We do not distinguish between projects that prohibit future development and those that allow redevelopment. In contrast, HUD distinguishes between these two models, referring to the former as a "buyout" and the latter as an "acquisition"; FEMA only funds the former, which it refers to as an "acquisition and demolition" project (HUD 2019; FEMA 2015(HUD 2019). Because FEMA funding accounts for such a significant share of buyout funding (Mach et al. 2019; Peterson et al. 2020), buyout properties that are redeveloped are relatively uncommon.

al. 2012). An analysis of transfer of development rights (TDR) programs, which parallel floodplain buyouts in that both entail the transfer of real property rights, found that meeting administrative requirements, holding public meetings, finalizing contracts, and other non-purchase costs accounted for between 13 and 21 percent of total costs (Shahab et al. 2018).

Second, non-purchase activities (e.g., communication, planning) are critical for enabling community-driven buyout programs, but it is unclear how much human and financial capital is dedicated to those activities across different buyout projects (Siders 2018). Understanding the costs of non-purchase activities can help ensure that such activities are adequately funded. Thus, the lack of information on the magnitudes of costs incurred on various floodplain buyout activities across federal, state, and local-level actors impedes efforts to strike a balance between streamlining buyout processes while supporting critical engagement activities.

In this study, we aim to assess the full costs associated with buyout projects, in particular those costs imposed by federal policy requirements. We begin by briefly covering the existing federal funding structures for floodplain buyout projects, and then define a typology to classify costs of buyout activities as production costs, transaction costs, or transaction costs imposed by federal policy. We then explore three sources of data to quantify the activity-level costs incurred in a typical buyout project in the U.S.: administrative records of FEMA-funded hazard mitigation projects; the peer-reviewed and grey literatures; and budget documents from a sample of local, county, and state governments that have implemented floodplain buyouts.

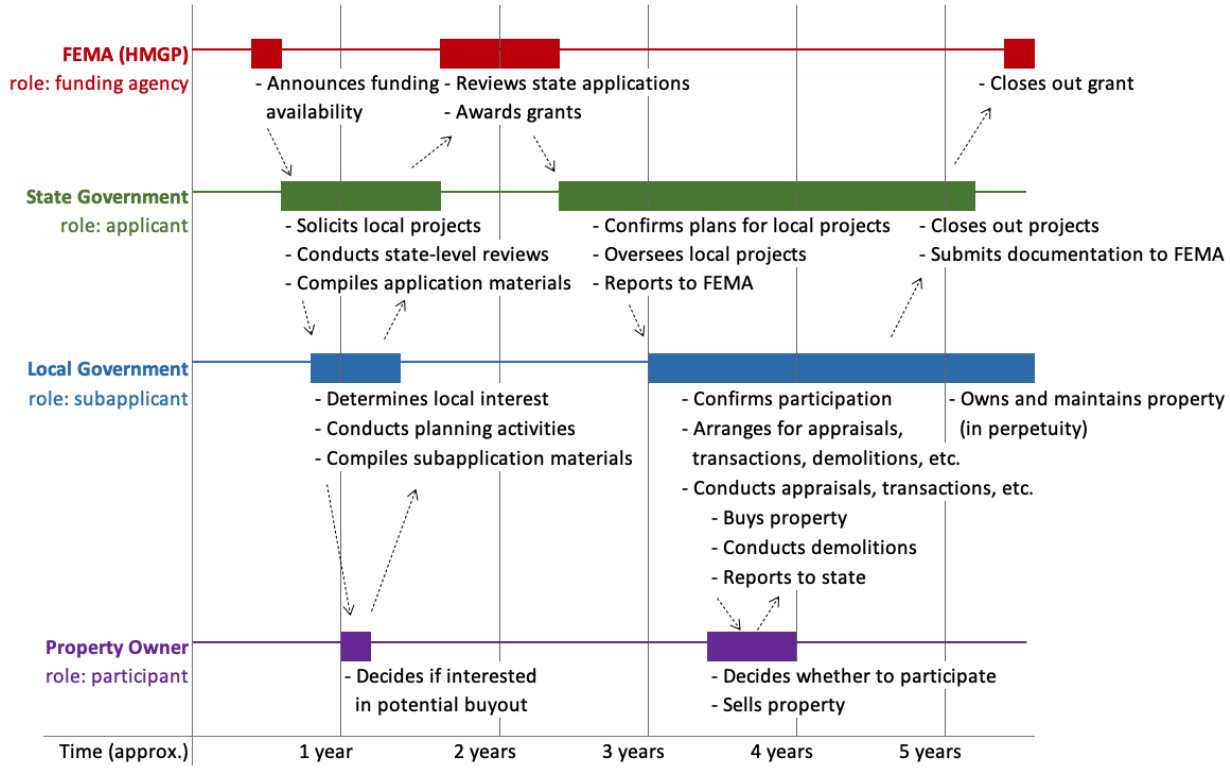
# 2. Background

## 2.1 Structure of Federally-funded Buyouts in the U.S.

The majority of buyout funding in the U.S. comes from federal government sources, including the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance programs—in particular the Hazard Mitigation Grant Program (HMGP)—and the Department of Housing and Urban Development's (HUD) Community Development Block Grant - Disaster Recovery (CDBG-DR) program (Peterson et al. 2020). These programs, which fund buyouts in addition to other hazard mitigation and disaster recovery efforts, have supported floodplain buyouts for the past three decades (FEMA 2018). Most federal buyout funds require a 25% non-federal cost match, whereby states, local governments, or other entities (e.g., foundations [e.g., UNC CRC 2018], property owners [e.g., Kummerer 2019]) cover a portion of buyout costs. Some states and local governments also operate their own floodplain buyout programs, which can be funded through stormwater fees, sales tax increments, legislative appropriations, or other sources.

A typical FEMA-funded HMGP buyout project is illustrated in Figure 1. Under this program, states are the primary recipients for hazard mitigation funding. States work with local governments to compile an application of mitigation-eligible properties, and then send a single, statewide application to FEMA. If awarded, states then take these funds and distribute them to local governments, which interface with property owners and conduct—or contract out—many of the buyout implementation activities. HUD's CDBG-DR program follows a similar general structure wherein federal funds are awarded to states, which often then sub-grant funds to local governments for implementation (HUD 2013).

**Figure 1.** Timeline of a typical HMGP-funded buyout. Reprinted and adapted with permission from Weber and Moore (2019).




As depicted by Weber and Moore (2019; Figure 1), the typical buyout project involves multiple actors engaged in a complex series of sequenced activities. This program structure, which is further complicated by a reactive and irregular cycle of buyout funding (funding is allocated in the wake of major disasters; Martin et al. 2019), may create inefficiencies, including: 1) burdensome and overlapping application, reporting, and project management processes between different levels of government and across federal funding agencies (Greer and Binder 2017; Mach et al. 2019; US GAO 2021; Kick et al. 2011); 2) fractured authority across and within local, state, and federal agencies, leading to conflicting guidance and interpretations of project requirements (Fraser et al. 2003; Greer and Binder 2017; Mach et al. 2019; Kick et al. 2011); 3) a need for high levels of staff capacity at the local level (Mach et al. 2019; US GAO 2021; Martin et al. 2019), despite the fact that many buyout projects, and the communities implementing them, are fairly small; and 4) marginal economies of scale as a result of municipal implementation of projects,

147 which often acquire only a single property (the median and mean FEMA-funded buyout projects acquire
148 only three and eleven properties, respectively [FEMA 2020b]).
149
150 These structural inefficiencies can burden government staff involved in the buyout funding and
151 implementation pipeline, and they also lead to an extremely drawn-out process; Weber and Moore (2019)
152 found that the median HMGP buyout project takes over five years from flooding to project close-out, and
153 CDBG-DR-funded projects appear to be similarly lengthy (Martin et al. 2019). Both required staff time
154 and project duration may have negative implications for property owners and implementing governments.
155
156 For property owners, the long, drawn-out process can lead to program attrition, with participants who
157 initially signaled interest in a buyout either deciding to repair their home and remain in place; sell to a
158 third party; or walk away from their property altogether (Binder et al. 2020). Thus, the delay between a
159 flooding event and closings on participants' properties reduces the number of acquired properties, leaving
160 residents at risk of future flooding. Further, delays can lead to residents sustaining additional, subsequent
161 flooding while waiting for buyout offers associated with the initial event, producing compounding health
162 and quality of life concerns. For those residents who do hold out, the length of the buyout process creates
163 an extended period of uncertainty and liminality. Residents must either continue to live in their flood-
164 damaged properties in substandard and potentially unsafe conditions, or they must find temporary
165 alternative housing, awaiting a buyout offer that will enable them to move to more permanent housing
166 (Baker et al. 2018).
167
168 According to a survey conducted a year after Hurricane Harvey struck Texas, 19% of all respondents—
169 and 27% of Hispanic respondents and those with incomes under 200% of the poverty line—reported that
170 their flood-damaged homes remained unsafe to live in (Hamel et al. 2018). Both for residents who
171 eventually have their properties acquired and for those who are interested but do not receive a buyout, the
172 process also entails time costs. Prospective participants must learn about the details of the particular

173 buyout project and the qualifications required for becoming eligible for a buyout; obtain property records
174 and other required documentation; and navigate legal processes, such as contesting property valuations
175 and completing property deed transfers.
176
177 Implementing agencies, both local and state, are also impacted by program attrition. As Binder et al.
178 (2020) note, agencies tend to focus on buyout programs as mitigation tools that can reduce future flood
179 losses and facilitate better land use and infrastructure patterns. Yet, attrition results both in fewer acquired
180 properties—and thus smaller reductions in future flood losses—and poorer land use outcomes as a result
181 of "checkerboarding"[2] patterns of property acquisition. Technical capacity barriers and administrative
182 burdens associated with applying for and implementing buyout projects may also lead governments to
183 either eschew such programs altogether, or to reduce the number of acquisitions they undertake in order
184 to limit this burden (Mach et al. 2019; US GAO 2021; Martin et al. 2019).
185

186 ## 2.2 Defining Transaction Costs in Floodplain Buyouts

187 Transaction costs, in the context of government programs, have been previously defined as those "costs
188 associated with the design and implementation of public policies" (Meyer et al. 2011). A transaction cost-
189 oriented analysis may be particularly salient to evaluating federally-funded buyout programs because it
190 focuses on the structural arrangement of activities—how responsibilities are allocated between different
191 actors, and across different levels of the funding hierarchy—and can thus inform efforts to create better
192 structures (Bryson and Ring 1990).
193

[2] "Checkerboarding" refers to a common pattern in buyouts where acquired properties are not clustered. Checkerboarding can preclude efficiencies that local governments might otherwise achieve from discontinuing sewer, water, and road maintenance, leading to areas with clustered buyout properties (BenDor et al. 2020).

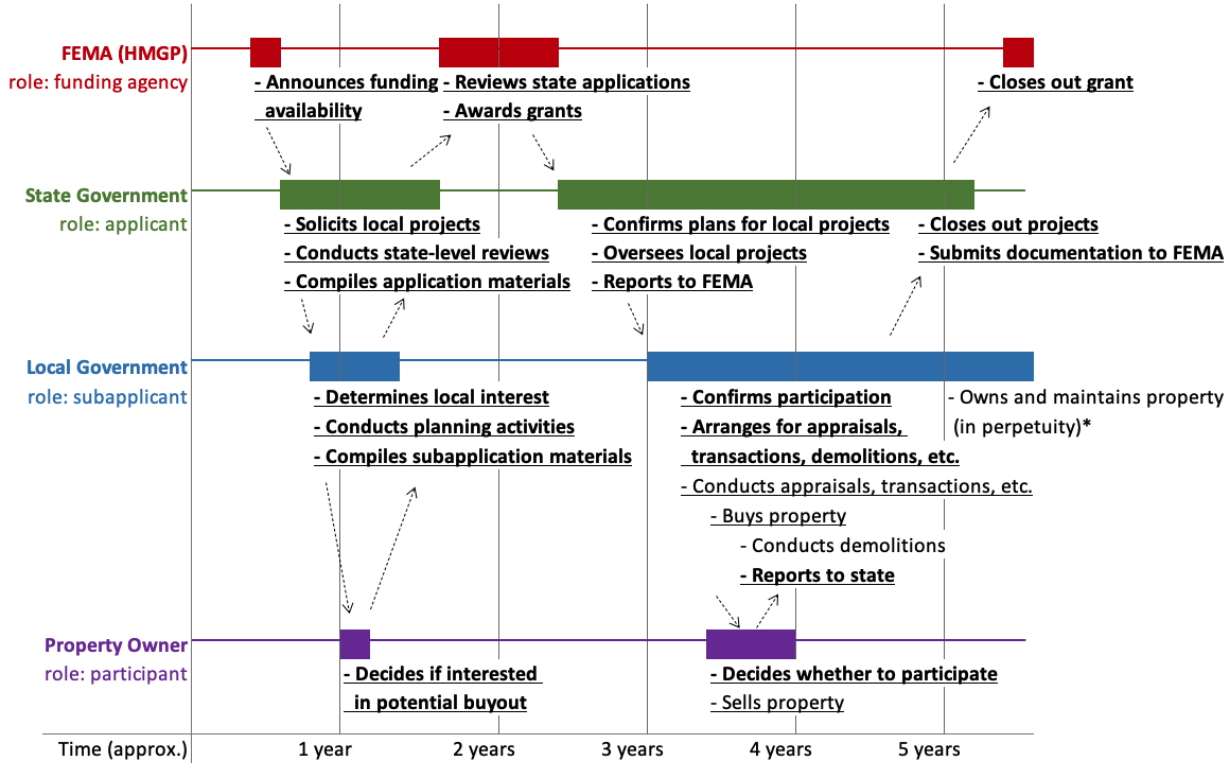
Though they do not use the term "transaction costs", federal funders are concerned about the magnitude of funding devoted to ancillary activities required to implement buyout projects. Both HMGP and CDBG-DR have policies that define and limit "management" and "administrative" costs. HMGP caps the portion of awards that may be spent on "management" costs—such as developing and compiling applications, providing technical assistance, managing grants and reporting, and all other indirect costs—to no more than 10% of the grant award for states, and no more than an additional 5% for sub-applicants (FEMA 2020a). CDBG-DR typically caps administrative costs—such as budget development, monitoring and evaluation, and grant reporting—at 5% of the total grant amount, with no restrictions on which entities (states or local governments) incur these administrative costs. CDBG-DR also limits "planning and general administration costs," which comprise items such as leased office space and salaries for staff with general oversight responsibilities, to no more than 20% of the grant award (HUD 2019).

While these policies limit how federal funds are budgeted, they do not necessarily limit how buyout costs are incurred. For example, grantees may shift buyout responsibilities to staff that are not listed on grant budgets in order to avoid exceeding funding limitations, or they may budget staff time under program delivery activities when in fact staff are spending part of that time on administrative or management activities. Further, FEMA's and HUD's funding policies do not require activity-level cost accounting, and thus provide little insight into which administrative or management components of buyout projects might be optimal targets for reform.

We begin our investigation of activity-level buyout costs by classifying buyout activities as incurring either "buyout transaction costs", more general transaction costs, or production costs. Following Buitelaar (2004), we operationalize transaction costs by evaluating whether each activity would be necessary given a frictionless market, where information is acquired and property rights exchanged without any cost (North 1990, pg. 11). However, because our interest is in transaction costs produced by federal buyout policy, not those resulting from other institutions that create market friction (e.g., requirements for a

notary to witness and sign a deed transfer), we classify activities as incurring either "buyout transaction costs"—costs resulting from federal funding requirements; general transaction costs—those costs, such as closing costs, that would not occur given a frictionless market, but that would occur even if the buyout were not funded with federal dollars; and production costs—those costs that would occur even in a frictionless market. In Figure 2, we present the application of this approach to the various buyout activities identified by Weber and Moore (2019).

**Figure 2.** Timeline of a typical HMGP-funded buyout, with buyout transaction cost-incurring activities bolded and underlined, general transaction costs underlined, and production costs in plain text. Reprinted and adapted with permission from Weber and Moore (2019).




* Site maintenance differs from other buyout activities and is discussed further in the text.

All of the costs associated with activities preceding the award of grant funds necessarily constitute buyout transaction costs: these activities are purely functions of the structure of the funding mechanism. For the same reason, the various reporting, oversight, and project close-out activities at the local, state, and

federal levels also constitute buyout transaction costs. Indeed, the first costs that are not buyout transaction costs do not occur on average, according to Weber and Moore (2019), until between three and four years after the precipitating flood event, and result from conducting property appraisals (general transaction cost), buying and selling the property (general transaction costs), and demolishing any structures on the property (production cost). Although not enumerated in Figure 2, this phase also frequently entails environmental assessments—e.g., for asbestos—and remediation, as well as historical preservation reviews. These activities constitute general transaction costs because each would likely be necessary even if there were no federal funding requirements; in order to demolish any structures, historical and environmental reviews and remediation would likely be required by local, state, or federal law, while appraisal and the actual sale of the property are processes familiar to anyone who has ever purchased property. However, because implementing governments have to arrange for contracts with external firms to conduct these tasks (appraisals, environmental reviews, demolition), for example by putting these tasks out to bid, there are also buyout transaction costs incurred at this stage of a project.

Lastly, site maintenance differs from other activities listed in Figure 2 in that it is not a requisite part of a buyout project, but rather is a function of post-buyout land use as determined by the local government (Zavar and Hagelman 2016). For example, a local government might devote no resources to site maintenance, might develop and maintain a site as a public park, or might have volunteers maintain the property. As such, we omit site maintenance from our classification of buyout activity costs, though in subsequent sections of the paper we include reports of site maintenance costs in order to develop a more comprehensive understanding of all buyout-related costs.

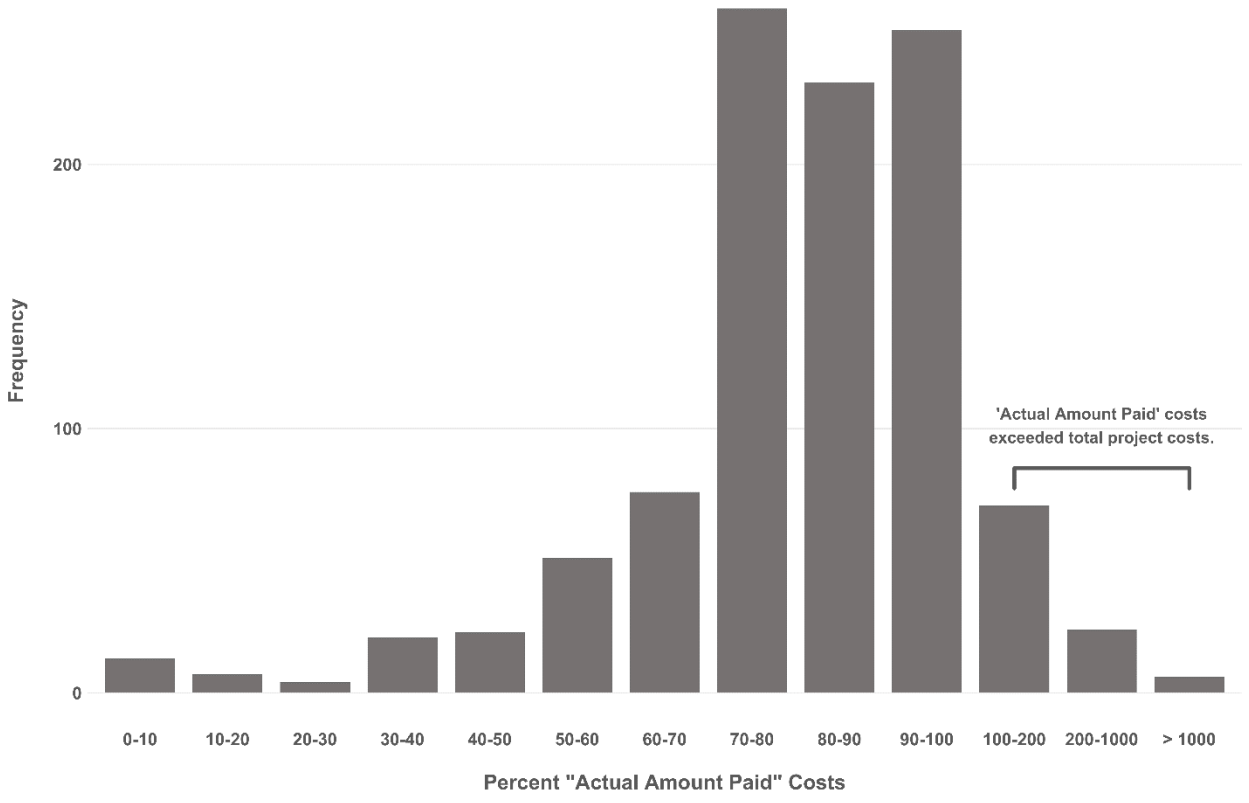
## 2.3 FEMA Administrative Records

One potential source of information on buyout costs comes from FEMA, which publishes a number of datasets containing administrative records pertaining to funded hazard mitigation projects. Two of these datasets—one with property-level information (FEMA 2021b), and another with project-level information

(FEMA 2021c)—provide relevant cost data for all FEMA-funded hazard mitigation projects dating back to 1990. We joined these datasets, removed projects that were not related to floodplain buyouts, and summed property-level "Actual Amount Paid" costs to the project level. "Actual Amount Paid" values are proxies for property purchase costs, which aren't reported by FEMA; we discuss challenges with this variable below.

Across the 1037 floodplain buyout projects included in these datasets, which in turn account for 5,586 acquired properties, the median and mean percentage of project costs spent on "Actual Amount Paid" activities were 84% and 332%, respectively (SD: 450%; IQR: 74% - 94%). Approximately 16% of projects (*n = 170*) spent two-thirds or less of their funds on "Actual Amount Paid" activities (see Figure 3).

**Figure 3**. Percent of total project costs (*n = 1037* projects) represented by "Actual Amount Paid" costs.



As evidenced above and shown in Figure 3, there are significant issues with data quality that leave us hesitant to draw any conclusions from these results. For example, FEMA inconsistently calculates its "Actual Amount Paid" variable, which doesn't necessarily equal the market value of the property: this value reflects an unknown combination of the amount paid to the property owner by FEMA, previous disaster aid received, and related costs, such as those for appraisals, closing, and demolition. In addition, many projects (*n = 101*; 10%) had "Actual Amount Paid" values that exceeded their total project costs; these projects are shown in Figure 3 as having percent "Actual Amount Paid" costs greater than 100%. While we cannot explain these values, this likely points to poor data quality control or incomplete reporting. These data are also limited in that they do not capture costs incurred at the federal level, nor those incurred by individual homeowners, e.g., the time spent determining one's eligibility or completing program paperwork. They also do not allow us to break down broad cost categories into more relevant activity-level costs.

# 3. Methods and Data

We take a two-pronged approach to address our research questions, conducting a systematic review of the peer-reviewed and grey literatures, and analyzing the budgets of a sample of communities, counties, and states that have conducted FEMA-funded buyouts.

## 3.1 Systematic Review

To investigate the extent to which buyout transaction costs are documented in the literature, we searched relevant publications using the Google Scholar citation search engine. Prior work has found that Google Scholar provides similar coverage of peer-reviewed articles compared to databases such as PubMed, though it may be less specific with the articles included in search results (Anders and Evans 2010; Freeman et al. 2009). Google Scholar aims to index scholarly publications—e.g., "journal papers, conference papers, technical reports, or their drafts, dissertations, pre-prints, post-prints, or abstracts"

(Google Scholar 2021)—and thus we did not systematically review lay sources, such as newspaper articles or op-eds, though some such sources were included in our result set as a function of Google Scholar's indexing algorithm.

We developed suitable search terms by testing different combinations of keywords and Boolean operators and informally evaluating the quality of results. We then corrected for problematic observed factors, such as significant numbers of false positives (e.g., "corporate buyouts"). We also consulted with colleagues involved in a related literature review of flood-induced managed retreat, and ultimately arrived at the search string:

("flood" OR "floodplain")

AND

("buyout" OR "property acquisition" OR "land acquisition" OR "home acquisition" OR "house acquisition")

AND

("cost" OR "process" OR "activities" OR "evaluation" OR "analysis").

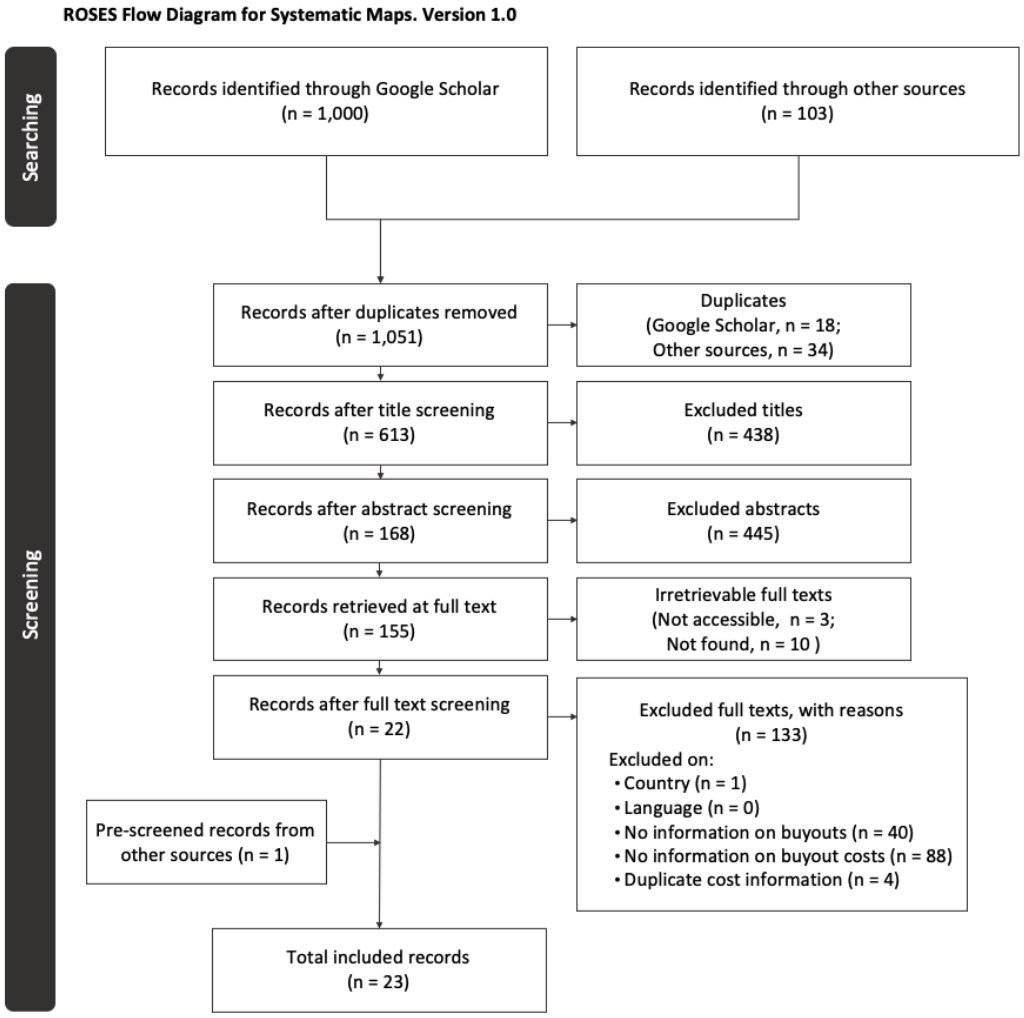
We used the bibliometric software *Publish or Perish* (Harzing 2020) to obtain our list of references. *Publish or Perish* provides an interface for "scraping" the results of literature database searches so as to reduce the manual labor required to individually translate results into a workable format for analysis. Using this platform, we examined the metadata for the first 1,000 results returned by Google Scholar for our search string. We also solicited additional, relevant documents for review from a network of scholars in this area and incorporated the resulting 103 publications.

After identifying and removing duplicates, we employed a three-tier screening process for evaluating each result: title review, abstract review, and full document review (Figure 4). For inclusion, we required that results be written in the English language and provide data on the monetary or person-hour costs of

floodplain buyouts conducted in the U.S. Results were excluded if they did not provide information about floodplain buyouts; if they only presented grant award data; if they did not provide standardized cost estimates (e.g., provided total property purchase prices but did not specify the number of properties or the area of land purchased); or if they were prospective (e.g., modeling costs, benefits, or damages). Results that referenced staff work but did not specify the amount of time dedicated to an activity were also excluded.

We were unable to obtain 13 of the 1,103 records that we identified for review; ten were citations—publications that Google Scholar indexed by crawling reference lists of other records—that were not available online nor through institutional library services or WorldCat (OCLC 2020). The other three unobtainable records were listed on WorldCat but were unavailable due to COVID-19 limitations on library operations. Four full-text records were excluded because they only contained duplicate cost information, either because their entire contribution consisted of citing other included documents or because they presented the same results in different publication formats.

**Figure 4.** Record selection process for systematic review of buyout cost literature. Source: adapted from ROSES flow diagram by Haddaway et al. (2017).



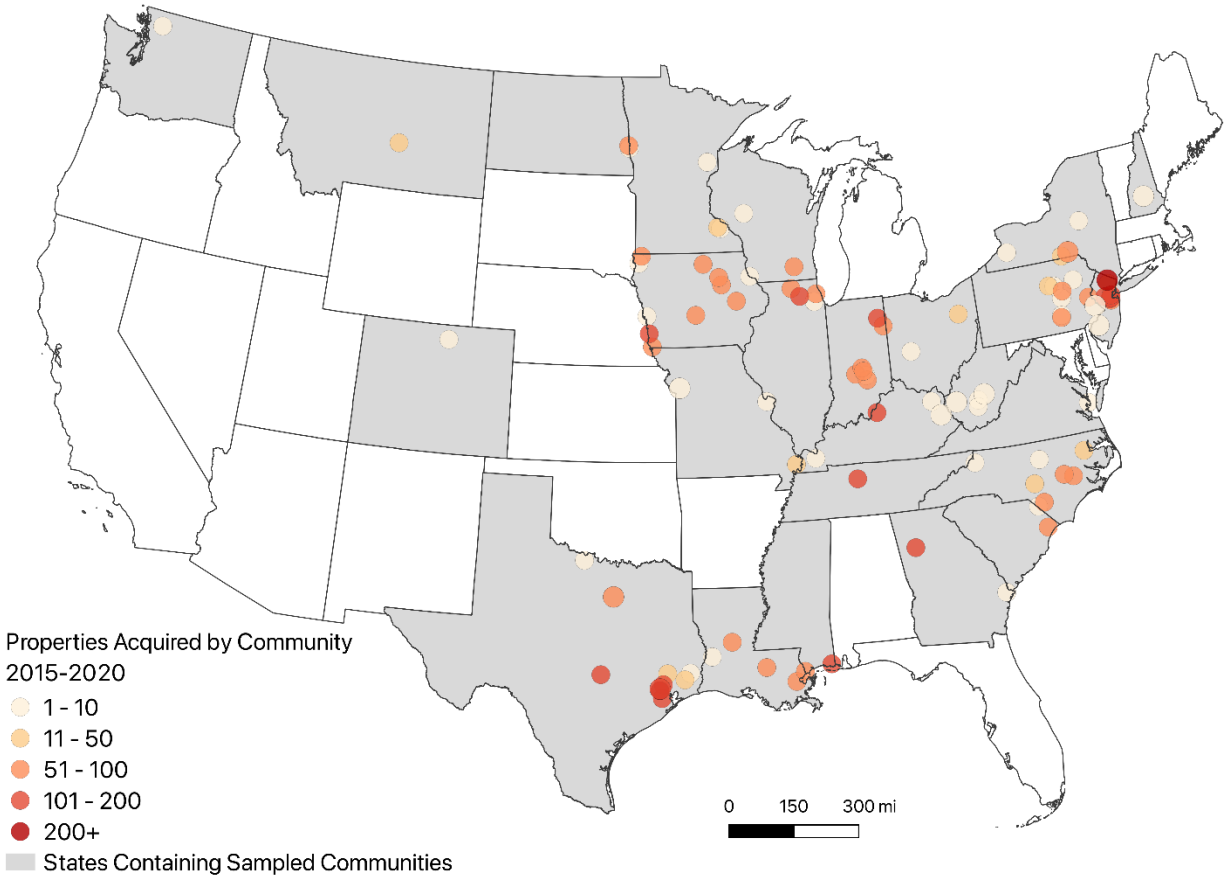

## 3.2 Budget Review

The second aspect of this project involved a budget analysis to determine how municipal, county, and state governments track and categorize their own spending on FEMA-funded buyouts. We relied on FEMA's public dataset of hazard mitigation projects (FEMA 2020b) to construct our sampling frame of municipalities for inclusion in this analysis. We retained only those municipalities that were denoted as having initiated riverine or coastal "acquisition/demolition" projects (i.e., containing "type" codes 200.1-200.4). Several trial efforts to review municipal budgets revealed a steep drop-off of available information

after five years (prior to 2015). Therefore, we limited our investigation to municipalities where buyouts were approved on or after January 1, 2015.

We used a random stratified sampling approach to over-sample municipalities that had acquired relatively large numbers of properties through floodplain buyouts, based on our hypothesis that these places were more likely to have relevant information in their budgets. We sampled every municipality with more than 50 properties acquired between 2015 and 2020 ($n = 48$ municipalities), and randomly sampled five percent of the remaining municipalities with 50 or fewer properties acquired over the same time period ($n = 50$ municipalities). For each sampled municipality, we also included in our sample the encompassing county and state, since multiple levels of government are often involved in administering buyout funding and activities. Because counties are often responsible for buyout implementation when major flooding occurs outside of larger, incorporated areas, we also sampled those counties where more than 100 properties had been acquired, which generated two additional observations (Kanawha County, WV and Brazoria County, TX; most such counties had already been included). Our resulting sample, shown in Figure 5, comprised 98 unique municipalities, 81 unique counties, and 25 unique states. However, after accounting for places where no budget-years were available, our effective sample comprised 67 unique municipalities, 62 unique counties, and 25 unique states.

**Figure 5.** Municipalities sampled for budget review (*n = 98*) by number of FEMA-funded properties acquired from 2015-2020. Note: while all states and U.S. territories were included in the sample frame, only the 48 conterminous states are mapped here to better represent those municipalities that were sampled.




For each municipality sampled, we implemented an online search for budget documentation from the fiscal year(s) during which the municipality was initially approved for funding, as well as the years directly after the approved buyout (until the earlier of either 2020 or the year in which the buyout project was officially closed out) to account for possible time lags in project implementation. We used this same process to identify budgets for encompassing counties and states. This generated a total sample of 859 budget-years. Of these budget-years, 223 (26%) were not available online, and an additional 76 (9%) were not machine readable (resulting in an effective sample size of n = 560 budget-years).

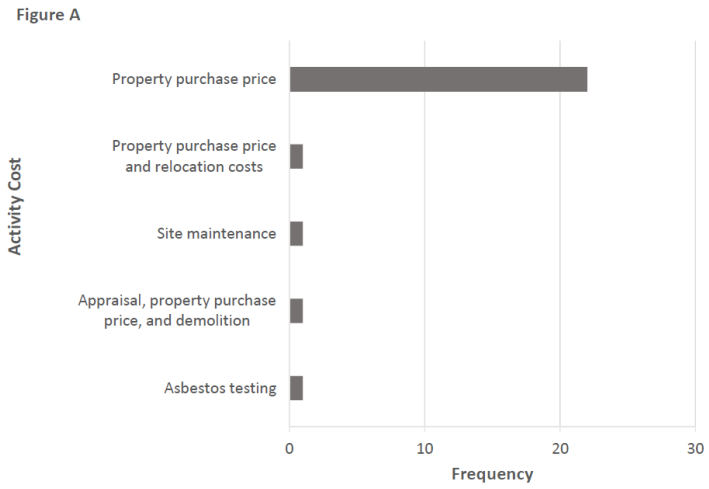
To identify potentially relevant text in the budgets, we searched each document for the keywords: "flood", "buyout", "FEMA", "hazard", "mitigation", and "acquisition." We then coded budgets iteratively, seeking a limited number of categories that were common across budgets and contained information relevant to buyout costs; we settled on "flood mitigation," "property acquisitions," and "flood buyouts." We documented flood mitigation and property acquisitions because budgets at times provided cost data on these broader budget categories instead of or in addition to information on the costs of floodplain buyouts. As our focus was the activity costs of buyout projects, only explicit expenditures were coded as present; if a budget discussed flood mitigation projects, for example, but did not provide cost data, that budget was coded as not containing relevant flood mitigation data. When a budget itemized floodplain buyout costs, we recorded total buyout expenditures, the full-time equivalent staff dedicated to buyouts, and resource allocations for the buyout activities identified in Weber and Moore (2019).

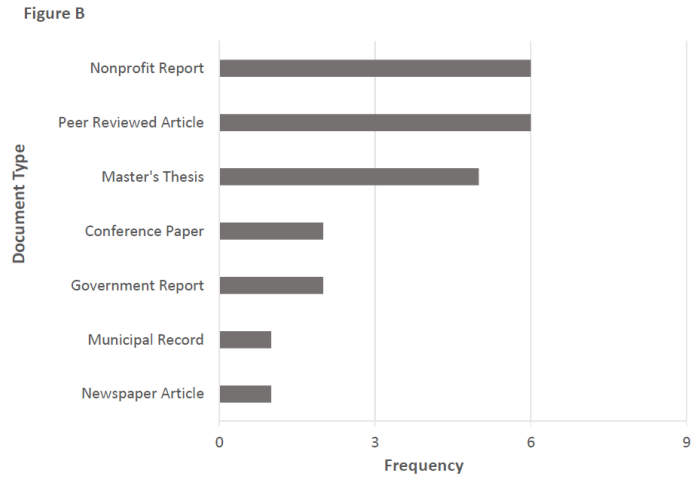
# 4. Results

## 4.1 Systematic Review

We identified very few published documents (*n = 23*; 2% of reviewed documents) that itemized the costs, either in terms of expenditures or person-hours, of specific activities comprising floodplain buyouts; these documents are described in Appendix Table A1. Of the 23 included documents, the large majority (*n = 19*; 83%) specified only property purchase prices, while three documents (13%) provided information on property purchase prices and another activity, and one document (4%) only described asbestos testing costs. Other itemized activity costs included site maintenance (4%); property purchase price and relocation costs (reported jointly; 4%); appraisal, property purchase price, and demolition (reported jointly; 4%), and asbestos testing (4%; see Figure 6a).

**Figure 6.** (A) Frequency (with percentage of total) of itemized activity costs among documents that included any cost information (total *n* = *23*). Note: counts and percentages do not sum to total because some documents itemized costs associated with multiple activities. (B) Frequency (with percentage of total) of analyzed documents, by publication type (total *n* = *23*).




While costs identified in the literature aligned with a subset of the activities described by Weber and Moore (2019; see Figure 1), there was no cost information for many activities—especially those relating to the administrative and communicative aspects of a buyout, such as the staff time required to inform residents about a buyout opportunity or to conduct benefit-cost analyses. There was also no cost information for activities undertaken by state and federal government agencies, nor for the costs incurred

by individual participants (e.g., learning about the buyout project and their eligibility; hiring legal support). Further, the cost information reported in most of the included documents was project specific – i.e., did not aggregate activity costs across projects—thus limiting the generalizability of findings. An important exception were the site maintenance costs reported in BenDor et al. (2020), which reflected a synthesis of data from multiple municipalities' buyout projects.

Included documents were published over a significant timespan, from 1987 through 2020, and by a range of entities, including both academic and non-academic sources (Figure 6b). While a quarter (*n = 6;* 26%) of documents were peer-reviewed journal articles, two-thirds (*n = 16*; 74%) were from the grey literature (e.g., government reports) or from lay sources (newspaper articles [*n = 1*] and municipal records [*n = 1*]). Google Scholar does not intend to index non-scholarly documents (Google Scholar 2021), which may explain the relative infrequency of these sources in our results. Notably, a municipal record—specifically, a city council meeting addendum—was the only document we identified that did not itemize property purchase prices, and was also the only document that specified asbestos testing costs (City of Waverly 2015).

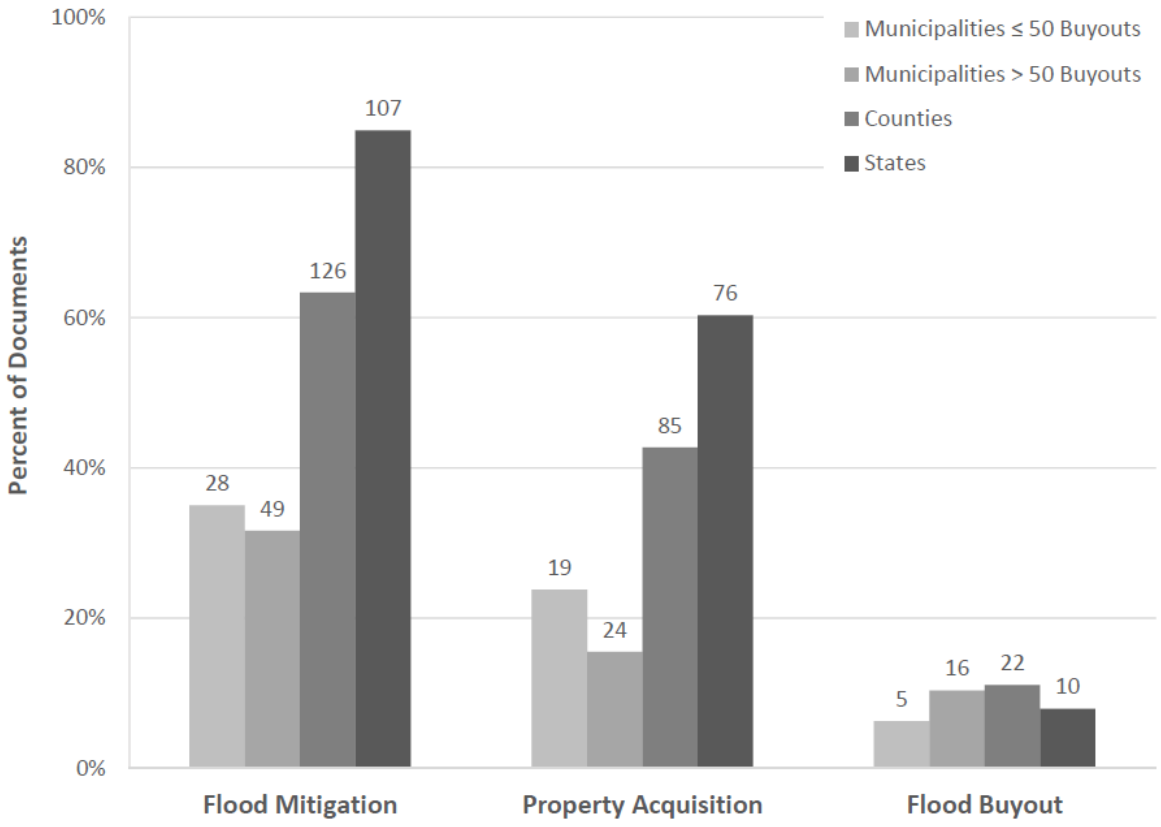
In 10 cases (43%), we were unable to disambiguate whether reported costs referred to overarching project costs or specifically to property purchase costs. For example, Plastrik and Cleveland (2019, pg. 22) wrote that "[The Charlotte-Mecklenburg stormwater utility] has spent $68 million to buy and demolish 400 buildings on its floodplain." Freudenberg et al. (2016, pg. 54) used similar language to describe the costs of a buyout program: "$48.4 million was awarded for the purchase and demolition of 196 homes in Sayreville [NJ] and $15.2 million was awarded for the purchase and demolition of 76 homes in neighboring South River." These descriptions of buyout costs are ambiguous for multiple reasons. For one, FEMA refers to buyouts as "acquisition/demolition" projects, which may contribute to the usage of "buy and demolish", "purchase and demolition", and similar terms as substitutes when referring to the myriad activities comprising a buyout. Further, grant awards cover more than just the discrete costs

associated with acquisition and demolition, such as staff costs for program implementation, suggesting that such phrasing may refer to total project funding as opposed to merely property purchase prices and demolition costs. Documents with ambiguous language are noted in Appendix Table A1 with an asterisk.

### 4.2 Budget Review

Overall, states over counties, and counties over municipalities, were more likely to have a website, a publicly-accessible budget, and explicitly report information on flood mitigation, property acquisitions, and flood buyouts expenditures. Of the budget-years comprising our effective sample (*n = 560*), 55% (*n = 310*) itemized flood mitigation expenditures, 36% (*n = 204*) itemized property acquisition (in a flooding context) expenditures, and 5% (*n = 29*) itemized floodplain buyouts (see Figure 7). None of the budgets that provided buyout cost information provided information on FTEs dedicated to buyouts or on how costs were broken down across the activities described by Weber and Moore (2019; Figure 1).

**Figure 7.** Percentage (and frequency) of study municipalities (categorized based on number of properties acquired from 2015-2020), counties, and states with budget information on flood mitigation, property acquisitions, and flood buyouts.




Despite drawing our sample from budget-years in which we knew HMGP buyout grants were active, only a small proportion of budgets itemized buyout costs. Of those that did, many described their buyout activities with only a single line-item in the budget; Manville's (NJ) 2018 budget (Borough of Manville 2019, pg. 48) is characteristic of this, with a single line-item, for $437,474, titled "Acquisition and Demolition of Flood Damaged Properties." Manville's budget also lists a number of other revenues and expenses that might relate to floodplain buyouts, e.g., a FEMA grant for $1,070,010 labeled "FEMA - 2018 Flood Mitigation", and a corresponding county matching grant for $118,890 labeled "FEMA - 2018 Flood Mitigation - County Match" (pg. 17). However, because FEMA-funded flood mitigation can encompass many non-buyout projects, such as elevations, these latter line items contribute little to our

understanding of buyout costs. Indeed, even the more specific buyout costs itemized in Manville's budget add little to our understanding of buyout costs because they provide no activity-level cost details.

Mason City's (IA) 2015 budget provided perhaps the greatest level of detail regarding buyout costs among the budgets we reviewed, both through narrative descriptions of buyout activities and through tabulations of revenues and expenditures relating to buyout projects. Of note, Mason City appears to have two standing funds that it uses to coordinate, at least in part, buyout activities: an "HMGP Voluntary Acquisition Special Revenue Fund" and an "FMA[3] Voluntary Acquisition Special Revenue Fund (pgs. 93-94)." While this budgeting approach included relatively detailed buyout expenditures—"Personal Service," "Contractual," and "Commodities" costs are all itemized—this breakdown does not meaningfully align with the functional components of a buyout project, but rather is a typology that Mason City uses to document expenditures across a range of funds and activities. Mason City's narrative describes completed and future-facing buyout activities in some detail: "The buyout and demolition efforts related to the June 8, 2008 flood event in the community are essentially complete, although a small area of an additional nine homes has been identified for a flood-related buyout. A Buyout Administrator coordinates this effort. A total of 169 houses were purchased and either demolished or moved due to the 2008 flood; the land will become permanent public open space (pg. vii)." While it is notable that Mason City has a role dedicated to coordinating its buyouts, this narrative text ultimately provides no information about activity-level buyout costs.

Because information specific to floodplain buyouts was limited, we also coded documents for expenditures relating to flood mitigation activities and property acquisitions that might constitute floodplain buyouts. These expenditures were potentially relevant to buyout costs for two reasons: they might encompass buyout costs, albeit without specifically denoting them; and they provide useful

[3] FMA refers to FEMA's Flood Mitigation Assistance grant program (FEMA 2020).

493 comparisons for evaluating whether the level of detail afforded buyouts in budgets was typical, or
494 whether places tended to provide less information about buyout expenditures than they did for other
495 similar classes of expenditures.
496
497 Ultimately, the details provided for flood mitigation and property acquisition expenses were no more
498 specific nor insightful than those provided for floodplain buyouts. Austin's (TX) 2016 budget (City of
499 Austin 2017) provides a representative example in its discussion of the Waller Creek Tunnel, which it
500 describes as a project designed "to address problems of flooding, erosion, and water pollution along [the]
501 lower Waller Creek (pg. vi)." The budget narrative refers to municipal bonds, a portion of which—
502 $11,051,000—were dedicated to the project for fiscal year 2016 (pg. 72), and an accounting of Capital
503 Projects Funds (pg. 164) notes the tunnel project has total assets of $8,249,000. Yet, akin to the buyout
504 projects described above, there are no additional details that describe how costs are incurred (e.g., for
505 labor, materials, land acquisition, etc.).
506

507 ## 5. Discussion and Conclusions

508 Neither the data that FEMA publishes, the scholarly literature, nor governments' annual budgets provide
509 reliable information about activity-level buyout costs. After reviewing over 1,100 scholarly documents
510 relating to floodplain buyout costs, we identified only 23 published documents that provided activity-
511 level cost information. Of a sample of 560 budget-years, we did not find a single budget that itemized
512 activity-level costs, though 9% ($n = 53$) explicitly listed the cost of overarching buyout projects, and a
513 number of others discussed buyout projects without providing cost information. The information available
514 often presents only a partial picture of the total costs, in that only property purchase prices or specific
515 grant awards are reported.
516

Our results, or the lack thereof, are particularly concerning in light of widespread evidence that buyout projects do involve extensive transaction costs, including communicating with potential buyout participants (Binder and Greer 2016; Martin et al. 2019), conducting benefit-cost analyses (FEMA 2015a; US GAO 2021) and environmental hazard reviews (FEMA 2015b), and completing administrative reporting requirements (Weber and Moore 2019; Martin et al. 2019). The lack of documentation may result because many local governments only sporadically engage in buyouts; if local officials have never implemented a buyout project before and do not expect to repeat the process in the future, there is little reason to capture any of the time or activity-level costs. There are also no requirements or incentives to do so by state or federal agencies—nor even guidance and tools to support such accounting—and logging hours and costs may be tedious. The result is that, in both budgets and the scholarly literature, grant awards and property purchase prices are widely reported, while other, less tangible project costs are not even mentioned. Yet, property purchase price information provides little basis for future projects to learn from and improve on past experience.

Incomplete reporting of buyout costs and the focus on property purchase costs also masks the potentially significant staff time across the many agencies and levels of government involved in a typical buyout project, both because state and local staff may informally dedicate their time to buyout activities, and because grant awards don't capture the costs of buyout projects incurred at the federal level. It also ignores the costs imposed on prospective project participants, who have to invest time to learn about the opportunity, complete paperwork, and wait—oftentimes for years—to receive a buyout offer. These buyout transaction costs may have implications for the equity of existing buyout structures: for example, prospective participants with fewer resources or less formal education may have to expend more time and money to navigate buyout processes than their counterparts and may be more likely to find these processes prohibitive to actually participating in a buyout.

The near total absence of any activity-level cost information is also highly problematic for efforts to learn from and improve buyout policy. Some activities, such as designing the buyout project along with the community and communicating frequently with property owners, are crucial to the outcomes of buyout projects. These activities should be supported to encourage more transparent and equitable buyout projects (Siders 2018). By contrast, other non-purchase activities may create delays without contributing significantly to enhancing participant and program outcomes. Without activity-level data, it is impossible to identify where transaction costs can be eliminated and where additional funding may be needed. Activity cost data could support other aspects of program reform as well: for example, data from a range of projects would enable evaluators to examine whether there are economies of scale for projects acquiring many properties, which might in turn inform efforts to consolidate buyout project implementation at the county level when properties are scattered across multiple municipalities.

The lack of systematic cost information to date, and the challenges associated with aggregating such information from alternate sources, such as departmental budgets and grant awards, also points to the need for better financial data collection standards by FEMA and HUD. A simple budgeting tool that aligns with the activities identified in Figure 2 could be integrated into existing project reporting processes for both FEMA- and HUD-funded buyouts. Over time, such data would allow for comparison of buyouts across funding mechanisms, support transaction cost evaluations of projects, and enable governments prospectively considering buyouts to better plan and budget for their estimated expenses. Until reporting standardizes and aggregates these data, future research might seek to systematically quantify the costs of the various activities that comprise typical floodplain buyout projects, for example through primary data collection from individuals engaged in funding and implementing buyouts.

Adjustments to program design could also affect the reach of existing buyout programs. Substantial transaction costs may be preventing local governments with less capacity from engaging in buyout programs at all (Mach et al. 2019), and reducing those barriers could open up access to a broader

568 population. Several jurisdictions have already instituted independently-funded buyout programs to
569 increase their own flexibility. For example, New Jersey's state-operated Blue Acres program blends
570 funding from HMGP, CDBG, state legislative appropriations, and the U.S. Department of Agriculture's
571 Natural Resources Conservation Service to conduct buyouts more quickly and strategically than is typical
572 (Weber 2019a; NJ Department of Environmental Protection 2015). Charlotte-Mecklenburg (NC)
573 Stormwater Services (SWS) operates a locally-funded buyout program that acquires properties within its
574 joint city-county jurisdiction in roughly six months after flooding. The program was developed in
575 response to the length of FEMA-funded buyouts, which led to higher program attrition and costs, as
576 buyout offers would have to pay for repairs and updates made in the intervening years after the
577 precipitating flood event. Notably, Charlotte-Mecklenburg's approach identifies potential buyout
578 properties before the flood so that SWS can execute acquisitions more quickly when flooding does occur
579 (Weber 2019b).
580
581 Although we collected and analyzed data from multiple sources in an effort to assess activity-level buyout
582 costs, our approach had a number of limitations. First, while our budget analysis examined a broad set of
583 municipal, county, and state budgets, we did not examine the budgets of other entities involved in
584 administering floodplain buyouts, such as flood control districts. We focused on jurisdictions' annual
585 budgets because these are almost universally required, although some jurisdictions' budgets (26%) were
586 nonetheless unavailable online. Future research might evaluate finer-grained sources of financial data,
587 such as grant awards, government contracting records, or the budgets of more specialized units, e.g., flood
588 control districts or individual government departments. However, these sources are much less likely to be
589 universally available than were annual government budgets, limiting the generalizability of any results.
590 Second, given that federal funding streams uniquely shape how buyout projects are implemented in the
591 U.S., we did not examine literature or other data sources relating to buyouts conducted in other countries.
592 While our results may be relevant to other countries' work to design and implement more efficient and
593 equitable buyout programs, efforts to reform U.S. buyout programs might also benefit from an extension

of this transaction cost analysis to buyout projects conducted internationally. Lastly, the sample for our budget analysis was drawn from FEMA records and thus did not necessarily include budget-years for jurisdictions that implemented buyouts without any FEMA funding. This was in part intentional, given that our primary focus in this paper was the application of activity cost data to reforming federally-funded buyouts. However, activity cost data from buyouts funded without federal assistance may be valuable in helping to characterize and learn from alternate approaches to implementing buyouts.

In summary, a more nuanced understanding of costs in relation to structural aspects of buyout projects may highlight existing best practices and help to promote policy learning, which has been limited to date (Greer and Binder 2017). By assessing buyout activity costs within a transaction cost framework, policymakers and program staff may identify and test alternate program requirements and project structures, with an eye toward minimizing staff burden and costs associated with activities that produce few benefits. These improvements will help property owners relocate more speedily, and cost savings and other efficiency gains will mean more resources can be devoted to core buyout activities that maximize participants' well-being and promote more equitable outcomes. Such efforts are urgently needed given the potential increase in demand for buyouts as the climate changes and flood damages grow.

# Appendix 1

**Table A1. Documents Identified during Systematic Review.**

| Citation | Title | Location | Enumerated Costs | Relevant Text | Document Type |
|---|---|---|---|---|---|
| (Harvey 2017) | After Retreat: Buyout Programs and Local Planning Goals after Hurricane Sandy | New York City, New York | Property purchase price | Figure 5.25 presents a histogram of property purchase prices. (pg. 61) | Master's Thesis |
| (City of Waverly 2015) | City of Waverly Agenda Memorandum: Dry Run Creek Improvements Approve Asbestos Testing and Abatement Services | Waverly, Iowa | Asbestos testing (not including abatement) | "Asbestos testing fees total $6,900 [for the nine properties]." (pg.1) | Municipal Record |
| (Siders 2013a) | Anatomy of a Buyout — New York Post-Superstorm Sandy | New York City, New York | Property purchase price | "Although the exact offer amounts have not yet been made public, the offer [for acquisition of one property] was in the range of $400,000." (pg. 12) | Conference Paper |
| (Freudenberg et al. 2016) | Buy-In for Buyouts: The Case for Managed Retreat from Flood Zones* | Sayreville, South River, New Jersey | Property purchase price | "$48.4 million was awarded for the purchase and demolition of 196 homes in Sayreville and $15.2 million was awarded for the purchase and demolition of 76 homes in neighboring South River." (pg. 54) | Nonprofit Report |
| (Boet-Whitaker 2017) | Buyouts as Resiliency Planning in New York City after Hurricane Sandy | New York City, New York | Property purchase price | Property purchase prices are provided in a table on page 52. | Master's Thesis |
| (Smith 2014) | Cedar Rapids Flood Buyout is History | Cedar Rapids, Iowa | Property purchase price | "[T]he 58 residential owners who appealed raised the total value of their properties by 14 percent from $4.1 million to $4.7 million." (pg. 3) | Newspaper Article |
| (Gonzalez et al. 2016) | Climate Change, Resilience, and Fairness: How Nonstructural Adaptation Can Protect and Empower Socially Vulnerable Communities on the Gulf Coast | New York City, New York | Property purchase price | "As of 2014, the NY Rising Buyout and Acquisitions program reports 505 properties participating, with $212 million disbursed for buyout and acquisition payments." (pg. 62) | Nonprofit Report |
| (BenDor et al. 2020) | Floodplain Buyouts and Municipal Finance | Charlotte, Greensville, Kinston, Lumberton, Rocky Mount, Seven Springs, Windsor, Raleigh, North Carolina | Property purchase price; site maintenance | "A majority of municipally owned lots are vacant patches of grass that are mowed several times year (sic) by public works or parks and recreation departments, incurring costs for staff, equipment, and fuel that total anywhere from ~$78 to $566/ha ($192 to $1,398/acre) annually." | Peer Reviewed Article |
| (McGinty 2017) | Home Buyouts: One Adaptation Approach to Rising Sea Levels | New York City, New York | Property purchase price | "Overall, New York State has spent $240 million to purchase 610 properties through the NY Rising Buyout Program and $68 | Master's Thesis |

| | | | | | |
|---|---|---|---|---|---|
| | | | | million to purchase 395 properties through the NY Rising Acquisition Program as of October 2016." (pg. 23) | |
| (Huber 1987) | Land Acquisition in the Big Thompson Canyon Following the 1976 Flood | Larimer County, Colorado | Property purchase price | "Acquisitions by the Parks Department totaled 124 parcels purchased from 98 property owners at a cost of $1,547,771. Twenty-nine owners chose not to sell 34 parcels, the appraised value of which totaled more than $175,000." (pg. 245) | Conference Paper |
| (FEMA 2011) | Public and Private Sector Best Practice Stories for Acquisitions/Buyouts Activity/Project Types in All States and Territories relating to Flooding Hazards | US | Property purchase price | "Of the 173 properties FEMA reviewed for acquisitions in Mason City, 104 were approved at a purchase cost of $10 million." (pg. 2) | Government Report |
| (Curti 2015) | Strategies for Equitable Climate Change Adaptation: Lessons from Buyback and Elevation Programs in Rhode Island | Cranston and Westerly, Rhode Island | Property purchase price | "Homes bought back on Perkins Avenue were valued between $115,000 and $150,000 each and fell within HUD's CDBG-DR program requirements for low- to moderate-income households." (pg. 51) | Master's Thesis |
| (Tate et al. 2016) | Flood Recovery and Property Acquisition in Cedar Rapids, Iowa | Cedar Rapids, Iowa | Property purchase price | Table 1 presents the average cost of properties for HMGP- and CDBG-funded buyouts in Cedar Rapids. | Peer Reviewed Article |
| (Fraser et al. 2003) | Implementing Floodplain Land Acquisition Programs in Urban Localities* | Greenville and Kinston, North Carolina; Grand Forks, North Dakota; San Antonio, Texas | Property purchase price | "Greenville's buyout program has bought out over 450 homeowners at a cost of $24.5 million." (pg. 14) | Nonprofit Report |
| (Chizewer and Tarlock 2012) | New Challenges for Urban Areas Facing Flood Risks* | Fargo, North Dakota and Moorhead, Minnesota; Cedar Rapids, Iowa; Sacramento, California | Property purchase price | "The City of Moorhead purchased forty-nine properties in low-lying riverfront neighborhoods after the 2009 flood using $9.3 million of combined federal, state and local funding for flood mitigation projects." (pg. 1781, footnote 228) | Peer Reviewed Article |
| (Green Acres Program 2004) | State of New Jersey* | New Jersey | Property purchase price | "The Passaic River Basin Buyout Program has used nearly $15 million from the 1995 Green Acres Bond to acquire 123 homes in the river's flood hazard area." (pg. 33) | Government Report |
| (Muñoz and Tate 2016) | Unequal Recovery? Federal Resource Distribution after a Midwest Flood Disaster* | Cedar Rapids, Palo, and Iowa City, Iowa | Property purchase price; property purchase price and relocation | "The city acquired 93 residential homes in the Parkview Terrace neighborhood, purchased at 112% of the pre-flood home value. Including relocation expenses, the acquisition project was estimated to cost $22 million." (pg. 4) | Peer Reviewed Article |

| | | | | | |
|---|---|---|---|---|---|
| (Plastrik and Cleveland 2019) | Can It Happen Here? Improving the Prospect for Managed Retreat by US Cities* | Mecklenburg County, North Carolina | Property purchase price | "[The Charlotte-Mecklenburg stormwater utility] has spent $68 million to buy and demolish 400 buildings on its floodplain." (pg. 22) | Nonprofit Report |
| (Conrad et al. 1998) | Higher Ground: A Report on Voluntary Property Buyouts in the Nation's Floodplains* | Tulsa, Oklahoma; Houston, Texas; New Orleans, Louisiana | Property purchase price | "So far, nine homes have been cleared at a cost of $630,000. Since the 1970s, more than 900 buildings have been acquired and cleared from Tulsa's floodplains. The total cost has been slightly more than $20 million." (pg. 154) | Nonprofit Report |
| (Siders 2013b) | Managed Coastal Retreat: A Legal Handbook on Shifting Development Away from Vulnerable Areas* | Grand Forks, North Dakota; Soldiers Grove, Wisconsin; Ames, Cherokee, and Wapello, Iowa; Charlotte, North Carolina | Property purchase price; appraisal, property purchase price, and demolition | "Grand Forks used $171 million in CDBG funding from HUD to purchase 802 property lots located near the Red River in the center of town." (pg. 115) | Peer Reviewed Article |
| (UNC Institute of the Environment 2016) | Case Study: Kenosha County, Wisconsin | Kenosha County, Wisconsin | Property purchase price | "Homeowners that participated in the buyout were given the property's pre-disaster fair market value, which averaged around $110,000 per home." | Nonprofit Report |
| (Moscovitz 2018) | Adaptation through Acquisition: Planning for Home Buyout and Acquisition in the New York Region* | New York, New Jersey | Property purchase price | "650 properties had been bought out for $254 million dollars." (pg. 40) | Master's Thesis |
| (Pinter 2005) | One Step Forward, Two Steps Back on U.S. Floodplains* | Illinois, Missouri | Property purchase price | "In Illinois and Missouri, the two most heavily impacted states, 7700 properties were acquired at a cost of $56.3 million, including the relocation of the town of Valmeyer, Illinois." | Peer Reviewed Article |

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