

THE IMPACT OF PUBLIC COMMENTS: A QUANTITATIVE STUDY OF PUBLIC  
ENGAGEMENT IN THE NEPA PROCESS

by

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## LAND ACKNOWLEDGEMENT

We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.

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## **Abstract**

The National Environmental Policy Act (NEPA) serves as the foundational environmental legislation, aiming to merge environmental decision-making with democratic processes, resulting in environmentally conscious outcomes. Enacted in 1970, NEPA mandates a comprehensive environmental review process that assesses the social and environmental impacts of federal decisions. It is a procedural law emphasizing transparency and accountability, hypothesizing that public involvement enhances agency decisions. Current literature on public participation has been primarily theoretical, and broad, quantitative assessments of NEPA documents are limited. This study's objective is to evaluate elements of public participation in NEPA processes and its influence on the outcomes of actions conducted by US Federal Agencies. To address this, we created a rubric based on the theoretical work from previous literature on public participation. This rubric can be broken down into three criteria: how public comments are considered, what opportunities are provided for the public to engage in the NEPA process, and what is the extent of engagement. We assessed how often public comments lead to modification of alternatives, mitigation, or the selection of a new agency preferred alternative. In addition, we collected information on the public participation process outlined in the document. We randomly selected a total of 108 Environmental Impact Statement (EIS) processes based on agency and action type. Our data show that overall, agencies may not be selecting an entirely new preferred alternative, but they are refining plans by modifying alternatives and mitigation in response to public comments. The data suggests that the driving forces behind these changes lie outside of the opportunities provided to engage and the quality of public participation.

## CHAPTER 1: THE IMPACT OF PUBLIC COMMENTS: A QUANTITATIVE STUDY OF PUBLIC ENGAGEMENT IN THE NEPA PROCESS

### Introduction

Public participation is a fundamental aspect of democracy that aspires to ensure government decisions are made in the best interest of the people (Nabatchi and Leighninger, 2015). Particularly for environmental decision making, public participation is seen to lead to improved environmental quality and social outcomes, and can educate and build capacity among citizen participants, agency staff, and scientific experts (NRC, 2008; Bierle, 2002). The simple assertion is that public participation opens and improves agency decisions and leads to better outcomes (ELI, 2010). And some research has shown that involving a diversity of stakeholders in decision-making processes can lead to more innovative and equitable solutions, as well as increased public trust and support for decisions (Glucker et al., 2013; Kuhn 1999).

In the United States, several laws—including the Administrative Procedure Act (APA) of 1946 (Morrison, 1986) and the Freedom of Information Act of 1966 (Ginsberg, 2014)—institutionalized the concepts and practice of openness, responsiveness, and public participation as a necessary and critical part of federal governmental decision making. Building on such procedural approaches to governance, the U.S. Congress passed the National Environmental Protection Act of 1969, or NEPA (42 U.S.C. Section 4321). NEPA articulates, with a substantive focus on maintaining national environmental integrity, the procedural need for governmental transparency and accountability (Caldwell, 1993).

NEPA established a national environmental policy, required agencies to implement that policy, and created the Council on Environmental Quality (CEQ) within the Executive Office of the President (EPA, 2023; Schuster, 2012; Caldwell, 1998; CEQ, 1997). The CEQ, authorized by NEPA to oversee and guide agencies in implementing the law, developed procedural regulations requiring that all federal actions undergo rigorous environmental review subject to public scrutiny and comment (Yost, 2012; Goetz Phillips and Randolph, 2000). This included the directive that “agencies shall make diligent efforts to involve the public in preparing and implementing their NEPA procedures” (see CEQ document archive at <https://ceq.doe.gov/laws-regulations/regulations.html>).

Public participation occurs at two points in the NEPA process—in the scoping of possible environmental impacts and in response to draft environmental impact statements (DEISs). CEQ guidelines allow agencies discretion about how to conduct public participation and collect input for the scoping and DEIS comment processes, and about what to do with the public’s input (Eckerd and Heidelberg, 2019).

The goal of this paper is to assess the procedural and substantive effectiveness of public participation in the NEPA process and how public participation affects related outcomes of actions considered by U.S. federal agencies. To do so, we use elements in the framework of Emerson et al. (2022) to examine the public participation content in environmental impact statements produced by five federal agencies (namely, Bureau of Land Management, U.S. Forest Service, Federal Energy Regulatory Commission, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service) across three action types between 2000-2022.



Specifically, we use content analysis and statistical techniques (Proportion tests, Fisher's exact test and partial least squares logistic regression) to investigate (i) the opportunities provided for the public to engage in the NEPA process, (ii) the extent of engagement, and (iii) how public comments are considered by agencies in the preparation of environmental impact statements. In addition, we evaluate (iv) the incorporation of public comments in the preferred alternative selected in agencies' final environmental impact statements (FEIS).

### **Public Participation and Environmental Decision making.**

The nature, quality, and impact of public participation is the subject of ongoing debate in the public administration and related literature (Dudley, et al., 2018; Dalton, et al., 2017; Eckerd, 2014; Glucker et al., 2013; Neshkova & Guo, 2012; Bingham, Nabatchi, & O'Leary, 2005; Irwin & Stansbury, 2004).

Public participation often is contrasted through the lens of democratic versus bureaucratic objectives characterized by a tension between democratic engagement versus agency administration (Barton, 2002), between a focus on citizen engagement versus meeting agency goals and outcomes (Eckerd and Heidelberg, 2019), or in terms of normative versus instrumental outcomes (Nabatchi, 2010).

In a study of public participation in environmental assessment and decision-making, the National Research Council concluded that "the reason to engage the public is not simply because laws, regulations, and habit require it, nor is it only because public participation makes decisions more legitimate in the eyes of the public. Rather, substantial evidence shows that effective public participation can help agencies do a better job in achieving public purposes for the environment by ensuring better decisions and increasing the likelihood that they will be implemented effectively" (NRC, 2008, 226). Barton (2002) suggests that a functioning democracy and an effective administration can be mutually beneficial and supportive, and that "undemocratic measures" are not a necessary condition for a working administration.

However, other researchers have arrived at a more skeptical interpretation: they see that while public participation in administrative decision-making is "normatively desirable," they also conclude that administrators more often than not view participation as something to be tolerated, accounted for, or overcome in terms of the impacts or restrains it might impose on program performance or outcomes (Eckherd, 2014; Neshkova & Gua, 2012; Irwin & Stansbury, 2004). Or public participation is simply another means for administrators to manage and to use selectively to obtain information that might not otherwise be available, and, thereby, be useful in meeting administrative goals (Eckherd and Heidelberg, 2019). From this perspective, the public and public participation are neither powerless nor powerful, but seemingly actors and actions that fall into a middle zone of "tokenism" as theorized in Arnstein's "ladder of citizen participation," which characterizes degrees of citizen participation (and power) ranging from "nonparticipation" to "citizen control" (Arnstein, 1969).

Nonetheless, some researchers suggest that theoretically and empirically the tradeoff between public participation and administration can be justified both in normative terms and also through instrumental value. For example, in a study of state transportation agencies nationwide, Neshkova and Gua (2019) found that public participation is positively and significantly associated with better outcomes. Research such as this aligns more with the findings of the NRC (2008) and others and finds

unnecessary the characterization of public participation as a tradeoff between “the values of democracy and the values of bureaucracy.”

In addition, a range of factors might contribute to the degree of “success” of public participation efforts, including the design of the participation process, the resources allocated to it, and the willingness of decision-makers to consider public input (Sinclair & Diduck, 2017; Reed, 2008; Halvorsen, 2006, 2001). And several key challenges to effective public participation include unequal power dynamics between stakeholders, limited access to information and decision-making processes, and a lack of trust between decision-makers and the public (Hourdequin & other papers).

### **Public Participation and the NEPA Processes**

Not surprisingly, research on the role of public participation and the NEPA process has found differing results. Through a range of investigative methodologies, researchers have looked at public participation by evaluating EPA rating scores of agency EISs (Schuster, 2012), conducting interviews and surveys of agency NEPA professionals (Eckerd & Heilberger, 2019; Hoover & Stern, 2014a; Hoover & Stern, 2014b; Predmore et al., 2011), analyzing the content of NEPA documents (De’Arman, 2020; Ulibarri et al., 2019; Stern & Mortimer, 2009), and employing detailed case study analysis (Eckherd, 2014). It should be noted that many of these studies focus one agency in particular, the U.S. Forest Service; and several studies emanate from the same research center at Virginia Tech. We summarize the work and conclusions of these various studies.

Schuster (2012) examined EPA’s evaluative scores of the quality and substance of some 1100 draft and final EISs for the period 1970-1999. Finding no significant changes in EPA scores over time, he concluded that most agencies tend to follow “procedural correctness” with regard to soliciting public input and comments and, as a result, most often do not incorporate substantive changes into final NEPA documents. He suggests that agencies tend to follow procedures that will stand up in court and then make decisions with an agency bias—essentially following “pro forma compliance” with regard to considering public comments.

Eckerd and Heilberger (2019) interviewed 22 NEPA project managers, combined with online survey responses from another 42 NEPA professionals, to determine how public administrators understand public participation and how they manage the participation process. The respondents indicated that rarely did substantive decisions about environmental assessment change as a result of public input, and if there were changes, they were often marginal or minor. However, the researchers suggest that such a process, heavily favoring administrative or instrumentalist outcomes, was not “antiparticipation.” Rather, agency staff see their responsibility as managing both the procedure and outcomes of public participation, and thereby informing, but not necessarily overruling, their administrative and technical expertise. Thus, administrative decision-making more likely guides public participation than the reverse.

Hoover and Stern (2014a) interviewed key NEPA staff with the U.S. Forest Service and found that agency personnel have a great deal of discretion to increase the amount of substantive input they receive and the influence it may have on decision making. They found that agency staff often serve as gatekeepers to public participation through internal decisions and actions during the NEPA process. The researchers found that USFS staff value public participation as long as it provides a means to gather facts and other information related to land management. However, the researchers conclude that agency

staff who view public participation as merely a procedural necessity tend to achieve fewer desirable outcomes from the process.

In another study by Hoover and Stern (2014b), they report the results of an online survey of Forest Service NEPA team leaders to gauge their perception of public participation. The researchers collected data from nearly 500 respondents and found that some 60% of respondents thought that the public should, in fact, have a greater influence on the NEPA process than it seemed to have. This is in contrast with 24% of respondents who thought that the public had too much influence. Also, according to the responses from agency staff, there is a perception that there are constraints to public participation—i.e., that public-input process isn't living up to its potential—and that there might be conditions under which public influence could be enhanced.

Predmore, et al. (2011) used an online survey to determine USFS personnel views of the NEPA process. The researchers obtained 3000 completed surveys, which included structured responses and open comments. The study found that public participation principally serves the agency in two ways: as a procedural response to legal and administrative guidelines for the NEPA process, and as a means to engage individuals and organizations and thereby limit potential future adversarial interactions.

In another study of NEPA and the U.S. Forest Service, De'Arman (2020) examined how agency personnel handle, respond to, and incorporate public comments. The study employed qualitative content analysis of the agency's draft environmental impact statements coupled with in-depth interviews. The research looked at processes and discourses that might indicate public comment incorporation into final EISs. The study found that by incorporating comments that agency personnel find useful, the process can offer an appearance of effectiveness. The bottom line offered by the researchers is that public comments, even substantive responses, tend not to modify final EISs substantively.

Ulibarri, et al. (2019) suggest that little is known about the role and outcomes of public participation on the content of NEPA environmental assessments. The researchers evaluated public comments for 27 project documents, comparing drafts versus final EISs, and concluded that public input had little substantive impact on the final documents.

Stern and Mortimer (2009) examined types of procedures used in the NEPA processes of four agencies: U.S. Forest Service, National Park Service, and Bureau of Land Management, and U.S. Army Corps of Engineers. The researchers examined documents and conducted interviews with the agency's chief NEPA compliance officers and with other agency staff. Their research found four principal views about the role of public involvement in the NEPA process: (i) the public should be informed, because it is required, (ii) sometimes public input improves agency analyses and alternatives by providing information that otherwise would have been missing, (iii) interacting with the public in "meaningful two-way exchanges" can reduce conflicts and improve land management activities, and (iv) public involvement can assign responsibility and accountability to an agency, and thereby lead to improved decisions.

Eckerd (2014) used content analysis of three EIS case studies in the Washington D.C. area to derive variables from some 1200 public comments, as well as from the agency responses to those comments. Though limited in scope, the research found that most of the public comments were responded to by boilerplate language (99% in the case of one agency). Also, some 80% of the responses

to comments were ones that simply justified the agency's preferred alternative and thereby discounting the public's comments. The researchers found that among the three case studies, only about 6% of the comments could be considered "decision-altering." The researchers concluded that essentially public influence on agency decisions was minimal.

In summary, current work on public participation and the NEPA process suggests that agencies—while not exclusively but more likely than not—are in a more powerful or controlling position than citizens in terms of the participation-administration dynamic. The views from agency staff about public participation range from (i) public participation is something to be undertaken because it's required and public commentary can be managed depending on the agency's needs, to (ii) public participation is a useful means to agencies' ends, to informing and achieving necessary outcomes, and there can be an opportunity to build capacity, trust, and support of participants. The view or evidence that public participation is a major force in influencing agency NEPA-related decisions is essentially absent.

We enter this discussion, building upon the analyses mentioned previously, by asking similar questions but using a more robust and wider data set, a deeper examination of document contents, and more probing statistical techniques. For example, we examine content in multiple sections of EISs to see how public comments modified agency outcomes. We investigate how the process unfolded across multiple agencies with differing missions (land management, water infrastructure, wildlife protection, and energy development). We analyze public participation impacts across multiple action types (categories of what an EIS is about). And we employ Proportion tests, Fisher's exact test and partial least squares logistic regression to analyze a suite of variables gleaned from the EISs.

How the EIS process is carried out, based on how closely guidelines and regulations were followed, is known as procedural effectiveness (Emerson et al., 2022). In addition, substantive effectiveness, or how effectively initial goals and objectives were achieved, will help us understand if outcomes are improving as a result of public participation. Effective public participation can increase trust between the federal government and the public, making the public more likely to support federal decisions in the future (Teschner, 2021; Yakubu, 2018).

To gauge procedural effectiveness of public participation, we focus on the opportunities provided for the public to engage in the NEPA process and the quality of the engagement. How agencies consider public comments and incorporate concerns or recommendations from the public into the final decision will illustrate the substantive effectiveness of the process. Together, these concepts help us understand whether or not public participation is meaningful and effective in achieving better outcomes.

## **Background on the NEPA Process**

### *How does NEPA work?*

NEPA requires federal actions to undergo an environmental review process, with categorical exclusions (CE) not requiring further review, and environmental assessments (EA) determining whether significant impacts will occur. If it is determined that significant impacts will occur, an environmental impact statement (EIS) is required. The EIS process ensures that significant impacts are analyzed, with the agency producing documents detailing the preferred action and alternatives, including disclosure of

all significant environmental and social impacts. These documents must contain scientific analysis of the affected area, with concise and comprehensible reports encouraged, along with mitigation and avoidance measures and reporting on any changes to the proposed action.

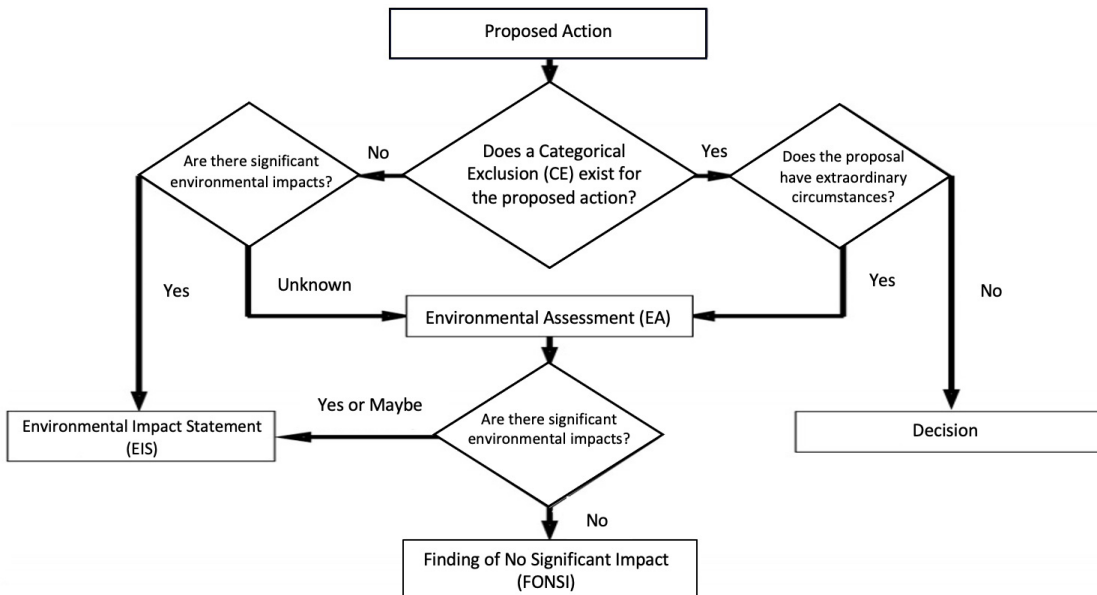


Figure 1 Flow chart of the NEPA process, beginning with the proposal of an action, followed by all subsequent paths possible based on environmental impacts. Source: (Government Accountability Office, [GAO], 2014)

### How is the public involved in the EIS process?

The public is involved from the beginning phases of the review process. Prior to any drafts or implementations, a scoping period occurs. The public can submit comments and concerns through mail, e-mail, and in-person at meetings. This notifies the agency of what concerns need to be assessed and addressed in the first draft of the EIS (DEIS). The agency composes the DEIS detailing the action, alternatives, social and environmental impacts, mitigation, and anything else relevant to the project and concerns of the public.

A 45-day waiting period takes place after the publication of the DEIS. During this time, the agency will host meetings and provide opportunities to receive feedback from the public. Any member of the public can comment on the process, and these comments must be considered in the final decision and responded to. All comments will be published in the Final Environmental Impact Statement (FEIS) along with any modifications or additions to the initial plan.

During both phases of public involvement, agencies must host public meetings. The content and agenda of these meetings is up to the agency; however, the goals of these meetings are outlined in CEQ guidance. The agency is to inform the public of the proposed action and the possible impacts of the action; and the agency is to receive written or verbal comments. The public may voice concerns regarding any aspect of the project. Comments deemed substantive by the agency may require further analysis or modifications to the original plan.

In each EIS, agencies may include a public involvement section where content from scoping and DEIS review meetings (such as comments, meeting times, meeting content and attendance) are

reported. Comments may sometimes be fully included or summarized in this section or included in an appendix with agency responses. There are no standard way agencies report these metrics, as agencies can have independent NEPA guidelines in addition to CEQ guidelines.

Agencies have discretion over dissemination of the EISs. Project websites, agency websites, and the EPA's EIS database are a few of the places an agency can post to. There are no single database agencies are required to use. These documents can be extremely difficult to find, especially after a process has concluded as project websites are taken down and projects are lost amongst other government documents.

Public participation is a cornerstone of NEPA. It is intended not only to lead to better outcomes but also to allow the public an active role in decision making through means of commenting and establishing legal standing.

### **NEPAccess**

NEPA has generated a substantial number of EIS, EA, and CE-related documents, including technical reports, supplementary data, raw information, and formal published documents. There are estimated to be over 40,000 EIS documents, while the exact numbers for EAs and CEs remain unknown. EAs and CEs constitute a significant portion of NEPA processes each year, yet there is currently no prescribed method for their publication.

Agencies are required to publish notices in the *Federal Register*, but beyond this requirement, there is no centralized repository for these documents. Some agencies independently create databases, use project websites, or release documents only upon request. However, these repositories may be incomplete, hard to locate, or not accessible to the public.

Additional challenges arise in organizing and structuring these documents because there are no unique process identification numbers to link a DEIS to a FEIS, an EA to a Finding of No Significant Impact (FONSI), etc. Documents can consist of numerous PDF files without descriptive labels, and some documents have not yet been digitized and made available online. Large studies of NEPA processes have been relatively inaccessible, and not without immense time and effort to track down documents and compile the relative information.

A notable development in this area has been the EPA EIS database. EPA has maintained a consistent database of records for every DEIS and FEIS received by the EPA since 1987, and the electronic PDFs for EISs received by the EPA since 2012. The EPA's database coverage spans across agencies and provides basic metadata for each document such as date, lead agency, and state. Although this has improved EIS availability, searching for projects can be difficult if the exact project title or date is unknown. This also does not include EAs, CEs, or PDFs for EISs prior to 2012. Several of the studies cited in our literature review used the EPA database as their source for EIS documents.

NEPAccess, a project funded by the National Science Foundation and developed by a team of researchers at the University of Arizona in Tucson, Arizona, seeks to remedy these gaps in accessibility. Through the use of data science and Artificial Intelligence (AI), NEPAccess strives to be a knowledge-discovery-and-engagement platform for the public, NEPA preparers, researchers, industries, and more. NEPAccess currently has over 18,000 PDFs, representing over 5,000 EIS processes. Through natural language processing (NLP), the advanced searching capabilities have made NEPA documents more

accessible than ever (Laparra et al., 2023a; Laparra et al., 2023b; Bethard et al., 2019). In addition to the basic metadata provided on EPA, cooperating agency, county, document type, action type, and decision type can be selected as filters to refine and narrow queries. In addition to title-based searching, NEPAAccess offers text-based searching and map-based searching, so whether the title, location, or date is known, there are several ways to find a specific process, or a culmination or processes based on search queries.

To our knowledge, NEPAAccess has the most complete database of EISs, with efforts now focused on expanding the repository to EAs, CEs, and other corresponding documents. The development of this new tool has supported this study and served as our data source. Now with access to more NEPA documents than ever before, NEPAAccess has enabled a new level of quantitative analysis of the NEPA process.

## **Research Framework**

Emerson et al. (2022) creates a framework to measure environmental impact assessment (EIA) performance. This framework was crafted from the current body of research on EIA performance, combining three dimensions of procedural effectiveness and substantive effectiveness. Both procedural and substantive effectiveness are broken down into “core elements.” These core elements pertain to all aspects of the EIA process, such as scientific analysis, process management, and efficiency. This paper will focus on the core elements pertaining to public participation.

Under procedural effectiveness, the core element of our focus is the nature of public participation. This is further broken down into “underlying functions” and “key variables.” The nature of public participation comprises the opportunities for the public to access and engage in the process and the quality of public engagement. The key variables for each function, respectively, are (i) agency efforts of public notification, (ii) extensiveness of opportunities for the public to participate, (iii) efforts to make engagement accessible to relevant communities, and (iv) the extensiveness of stakeholders’ participation and diversity of stakeholder participation. These key variables will make up our methods for data collection and analysis.

Substantive effectiveness focuses on measuring how the intended goals and objectives were achieved. The two core elements we will assess are the quality of the recommendation and agency decision, and the accountability of the final preferred alternative. The underlying function for the first core element is the substantiated recommendation, determined by modifications or refinements made from the initial proposal to the final preferred alternative, and confluent, the incorporation of information and public comments into the final preferred alternative. The second core element of substantive performance is the function of a responsive recommendation, comprising the agency’s consideration and response to comments.

Emerson et al. (2022) expands on the theoretical work on EIA processes to create a framework for real world application to measure performance and improve efficiency. They acknowledge the current body of quantitative work is limited, and oftentimes does not broadly assess the core elements outlined in their framework. Emerson et al. also acknowledges there are gaps as to where, when and how the EIA process impacts agency decisions. We believe a major mechanism of this is public participation, hence this study. The core elements, underlying functions and key variables related to public participation outlined by Emerson et al. are the basis of our research questions.

Procedural performance	Underlying functions	Key Variables
Nature of Public Participation	1. Opportunities for public to access information & engage in EIA process: Agency efforts to engage the public in the EIA process	1.1 Agency efforts of public notification 1.2 Extensiveness of opportunities for the public to participate 1.3 Efforts to make engagement accessible to relevant communities
	2. Quality of public engagement	2.1 Extensiveness of stakeholders participation and diversity of stakeholder participation
Quality of EIA Recommendation and Agency decision	3. Substantiated recommendation: Preferred alternative is informed by the analysis in EIA process	3.1 Modifications or refinements made from the initial proposal to the final preferred alternative 3.2 Incorporation of information and public comments into the final
Substantive Performance	Underlying functions	Key Variables
Accountability of Final Preferred Alternative	4. Responsive recommendation: Preferred alternative is responsive to expressed concerns	4.1 Consideration and response to comments

Table 1 Key performance variables related to public participation outlined by Emerson et al., 2022.

## Overarching Questions

Our general hypothesis is the hypothesis that is embedded in NEPA itself: public participation leads to better environmental and social outcomes. We will test this by answering these questions:

- I. Does public participation influence outcomes?
- II. What elements of public participation are most influential?

To address this this, we analyzed EIS documents for public participation information such as: the consideration of public comments, the opportunities provided for the public to engage in the NEPA process and the quality of the engagement.

## Research Questions

To answer our overarching questions, we have organized a series of questions to assess.

In regard to our first question, there are several ways in which public comments can influence outcomes. We will assess this by answering the following questions:

Q1. Do agencies select an entirely new preferred alternative because of public comments?

Q1a. Does the frequency with which agencies select an entirely new preferred alternative (because of public comments) differ between agencies?

Q2. Do agencies modify alternatives because of public comments?

Q2a. Does the frequency with which agencies modify alternatives (because of public comments) differ between agencies?

Q3. Do agencies modify mitigation plans because of public comments?

Q3a. Does the frequency with which agencies modify mitigation plans (because of public comments) differ between agencies?

To answer our second overarching question, we will analyze public participation metrics and response data from the three questions above to ask:

Q4. What elements of public participation are most influential on agencies selecting an entirely new preferred alternative, modifying alternatives, and modifying mitigation plans?



## Methods

### Data

We selected 108 EIS processes and collected public participation data from each of the associated 216 documents (i.e., 108 DEIS and 108 FEIS documents). Public participation data was collected from the DEIS review phase. The data used in this study were obtained from NEPAccess (described above).

### Study Design

In our study, we conducted a comprehensive search using NEPAccess to identify processes with a published DEIS and a FEIS. To ensure a diverse representation, we strategically selected using natural language processing techniques (Laparra, et al., 2023b) specific agencies and action types. Our criteria for selection focused on major agencies that engaged in various action types, promoting a broad spectrum of environmental impacts. We chose agency-action type combinations where there were at least six EIS processes. In cases where there were more than six EIS processes, we randomly selected six. Our goal was to cover the top EIS-producing agencies while including multiple types of actions. BLM and USFS produce a large amount of EISs of many action types compared to other selected agencies. The representation of BLM and USFS have been overweighted in this sample to account for that. Any exclusion of agencies (for example, Department of Transportation agencies) from the sample resulted from a lack of variation in action types; conversely, exclusion of certain action types stemmed from insufficient diversity in agency involvement.

The selected combination of agency and action type are as follows:

Agency	Action Type
Bureau of Land Management	Conservation/Restoration/Biological Resource Use
	Energy Generation/Transmission
	Mineral Resource Extraction
Federal Energy Regulatory Commission	Energy Generation/Transmission
	Mineral Resource Extraction
US Army Corps of Engineers	Conservation/Restoration/Biological Resource Use
	Mineral Resource Extraction
US Forest Service	Conservation/Restoration/Biological Resource Use
	Energy Generation/Transmission
	Mineral Resource Extraction
US Fish and Wildlife Service	Conservation/Restoration/Biological Resource Use
	Energy Generation/Transmission

Table 2 Selected agency and action type combination. A total of 6 processes were randomly selected for each combination, with a total of 108 processes.

To gather data for each process, we collected information from the DEIS and the FEIS of the selected processes.

Our sampling method accounts for the wide variability in structure and content of EIS documents among agencies, and from project to project within agencies. Focusing on specific agencies and action types enables us to avoid the problem of missing data, and to gather more complete public

participation information. It also allows interpretation of any relationships between agency, action type, and changes in decisions in response to public comments.

*Action type*

These action types were determined through natural language processing (NLP) algorithms trained by a process of machine learning and manual validation of the algorithm’s precision and accuracy. This algorithm automatically parses the document, finds keywords specific to that action type, and assigns an action type (Laparra et al., 2023).

The definitions for the selected action types are below:

Action Type	Definition
<b>Energy Generation and Transmission</b>	Actions that focus on generating or transmitting electricity
<b>Conservation and Restoration</b>	Actions to preserve, restore, or conserve natural resources
<b>Mineral Resource Extraction</b>	Actions that focus on extracting mineral resources from the environment

Table 3 Selected action types and definitions.

*Coding for the consideration of public comments*

Agencies will often provide reasoning for changes in the FEIS from the DEIS. This includes changes to alternatives, selection of a new preferred alternative, or mitigation. This information can be found in the main report of FEIS—agencies will often denote changes using italics, footnotes, underlining, or a separate section summarizing all of the changes. If it was not annotated as such, we searched several sections throughout each EIS. Any changes to these were recorded.

The selection of a new preferred alternative was determined by identifying the preferred alternative in the DEIS and FEIS. If it changed, the agency responses to comments, the public participation section, and the alternatives section were searched for any language suggesting a comment led to the selection of a new *agency preferred alternative*. If it is suggested by the agency’s language that a new preferred alternative was selected in response to public comments, this was recorded as a “yes”. If language did not suggest a new preferred alternative was selected in response to public comments, it was recorded as a “no”. Some agencies did not select a preferred alternative in the DEIS or FEIS and indicated it would be identified in the Record of Decision. These were coded as “None identified” and dropped from analysis.

Modifications to alternatives in response to public comments were determined by searching the agency responses to comments, the public participation section and the alternatives section for any language suggesting a comment led to modifications of the *alternatives*. If it is suggested by the agency’s language that alternatives were modified in response to public comments, this was recorded as a “yes”. If language did not suggest that alternatives were modified in response to public comments, it was recorded as a “no”.

Modifications to mitigation in response to public comments were determined by searching the agency responses to comments, the public participation section, the alternatives, and the mitigation section (if separate from alternatives section) for any language suggesting a comment led to

modifications in *mitigation measures*. If it is suggested by the agency's language that mitigation measures were modified in response to public comments, this was recorded as a "yes". If language did not suggest that mitigation measures were modified in response to public comments, it was recorded as a "no".

From the DEIS and FEIS we compared the alternatives, preferred alternative, and mitigation. If these change between documents, we record the changes and whether the changes occurred because of public comments. This information can be found in the main report of EIS, agencies will often denote changes using italics, footnotes, underlining, or a separate section summarizing all of the changes. We also searched the comment and agency response section for responses that stated revising alternatives or mitigation was necessary.

#### *Coding for opportunities for the public to engage in the NEPA process*

The following metrics regarding opportunities for the public to engage in the NEPA process were recorded from the DEIS review comments included in the FEIS: the number of meetings held, the length of the commenting period, efforts taken to notify the public and provide information, accessibility of opportunities, and the efforts taken to engage with especially impacted and marginalized communities.

Exact numbers of meetings were recorded, if the agency failed to include this information it was recorded as a "0". If the length of the commenting periods was not reported, then that process was recorded as 45 days (the minimum required by regulation for DEIS review). The specific efforts to notify the public were allotted one point for each method and ranged from: publishing a notice in the *Federal Register*, newspaper articles, advertisements on the radio, television, project websites, or notices mailed directly to addresses in the affected area. For accessibility, if agencies held meetings outside of work hours, provided multilingual information, offered in person-meetings, offered a virtual meeting option, or held meetings in locations central to the affected area, one point was assigned for each that applied. We also recorded if there were additional and unique efforts to engage with especially impacted and marginalized communities. If the agency fails to include any of this information, each was recorded as a "0".

#### *Coding for the quality of engagement*

To determine the quality of engagement, the following metrics were recorded from the FEIS: the number of DEIS review comments received, how many people attended DEIS review meetings, and the types of groups involved in public DEIS review.

Exact numbers of comments and attendees are recorded, using "0" as a response if the agency fails to include this information. All types of groups involved (at meetings or by commenting) were recorded (federal, state or local agencies, individuals, nongovernment organization, tribes) and a point was assigned for each group.

#### *Statistical Methods*

##### Proportion test

Using the data collected from research questions 1-3, we ran a proportion test for each question to answer our overarching question: does public participation influence outcomes?

Q1. Do agencies select an entirely new preferred alternative because of public comment? We used a proportion test to determine if the overall proportion of “yes” responses (a new preferred alternative is selected because of public comments) was greater than “no” responses (a new preferred alternative was not selected because of public comment).

Q2. Do agencies modify alternatives because of public comments? We used a proportion test to determine if the overall proportion of “yes” responses (modifications to alternatives were made because of public comment) was greater than “no” responses (modifications to alternatives were not made because of public comment).

Q3. Do agencies modify mitigation plans because of public comments? We used a proportion test to determine if the overall proportion of “yes” responses (modifications to mitigation plans were made because of public comment) was greater than “no” responses (modifications to mitigation plans were not made because of public comment).

The proportion test allows us to test if the overall proportion of yes responses to no responses is greater than the null hypothesis that all are “no” responses, or that agencies do not select an entirely new preferred alternative (Q1), modify alternatives (Q2), or modify mitigation plans (Q3) because of public comments.

#### Fisher’s exact test

Using the data collected for our first three research questions, we employed a series of Fisher’s exact tests to detect if there was a significant difference between agencies and a new preferred alternative being selected, modifications to alternatives occurring, or modifications to mitigation occurring. Given the structure and content of our data, a Fisher’s exact test was selected over a chi-squared test due to several observations having counts of 5 or less.

Q1a. Does the frequency with which agencies select an entirely new preferred alternative (because of public comments) differ between agencies? We used Fisher's exact tests to determine if there was a significant difference between “Yes”, an entirely new preferred alternative was selected in response to public comment, and “No”, an entirely new preferred alternative was not selected in response to public comment. We ran two Fisher’s exact tests to detect for a significant association between responses based on agency, and separately, action type. Two processes did not have a preferred alternative identified in the DEIS or FEIS, these were dropped from this analysis.

Q2a. Does the frequency with which agencies modify alternatives (because of public comments) differ between agencies? We employed Fisher's exact tests to determine if there was a significant difference between “Yes”, alternatives were modified in response to public comments, and “No”, alternatives were not modified in response to public comments. We ran two Fisher’s exact tests to detect for a significant association between responses based on agency, and separately, action type.

Q3a. Does the frequency with which agencies modify mitigation plans (because of public comments) differ between agencies? We employed Fisher's exact tests to determine if there was a significant difference between “Yes”, mitigation measures were modified in response to public comments, and “No”, mitigation measures were not modified in response to public comments. We ran two Fisher’s exact tests to detect for a significant association between responses based on agency, and separately, action type.

## Partial Least Squares Logistic Regression

The collected data above was then used in a partial least squares logistic regression (PLS-LR) to understand Q4: what elements of public participation contribute most to agencies selecting an entirely new preferred alternative, agencies making modification to alternatives, and agencies making modifications to mitigation plans. The collected information, referenced in “coding for the opportunities for the public to engage in the NEPA process” and “coding for the quality of public participation,” was used to create a rubric to score each process. If the length of the comment period is not explicitly stated, we deferred to the specific agency’s guidelines. If the number of meetings or number of comments was not explicitly stated and no comments were included in the document, it was assigned a zero.

1	2	3	4	5	6	7	8	9
Comment period length	Means to notify the public (+1 for each)	Number of meetings	Accessibility	Outside work hours	Multilingual info	Meeting format	Meeting location central to project area	Types of groups involved (+1 for each)
# of days	News, Federal Register, Radio, Project websites, Letters to the public in project area, TV ads	Total # of public meetings	Sum of columns 5-8	(+1)	(+1)	(+1)	(+1)	Federal agencies, State agencies, Local agencies, Organizations, Individuals, Tribes

Table 4 Covariates for PLS Logistic Regression. These were derived from the “key variables” outlined in Emerson et al.

A PLS-LR was run using the response variables from research questions Q1, Q2, and Q3, plotted against the predictors produced from the PLS-LR analysis. This comprised three total models—one for each research question. The model for the first research question had two processes where a preferred alternative was not selected by the agency in the DEIS or FEIS. These were subsequently dropped from this analysis.

Other variables were dropped from the rubric, as it was absent from a substantial number of documents. Any information on scoping, the number of attendees at DEIS review meetings, and additional outreach efforts to environmental justice (EJ) communities were dropped from this analysis. This information was not reported in a majority of the documents and could have misleading results.

## Results

*Consideration of Public Comments: Do agencies select an entirely new preferred alternative because of public comments? (Q1)*

Do Agencies Select an Entirely New Preferred Alternative because of Public Comments?			
Agency	Action Type	Yes	No
BLM	CRB	6	6
	EGT	3	9
	MR	3	9
FERC	EGT	0	6
	MR	1	5
USACE	CRB	1	5
	MR	1	3
USFS	CRB	2	10
	EGT	2	10
	MR	1	9
USFWS	CRB	2	4
	EGT	0	6

Table 5 Do Agencies Select an Entirely New Preferred Alternative because of Public Comments? Total counts broken down by agency and action type, n = 104. (CRB = Conservation/Restoration/Bio Resource Use; EGT = Energy Generation/Transmission; MR = Mineral Resource Extraction)

A proportion test was used to test whether the overall proportion of yes responses was greater than no responses ( $H_0 = p_{Yes} > p_{No}$ ). We reject the null hypothesis and conclude the proportion of yes responses to no responses is significantly less (p-value = 3.616e-09, 95% CI = [0, 0.2894963]).

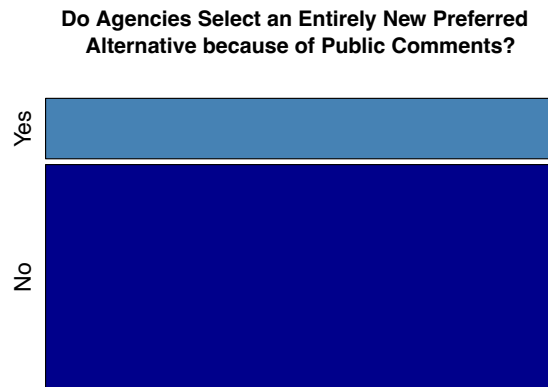


Figure 2 Do Agencies Select an Entirely New Preferred Alternative because of Public Comments? Total count of “yes” and “no” responses, n = 104.

*Does the frequency with which agencies select an entirely new preferred alternative (because of public comments) differ between agencies? (Q1a)*

A Fisher's exact test was used to determine across all of the action types within an agency, if there is a significant association of selecting a new preferred alternative in response to public comment and the action type (Figure 3). There was not a statistically significant association between response and action type for BLM (p-value = 0.49), FERC (p-value = 1), or USFWS (p-value = 0.45) projects.

USACE had two processes where a preferred alternative had not yet been selected and were subsequently dropped from the analysis. No significant association between action type and response was detected (p-value = 1, n = 10).

USFS had two processes where a preferred alternative had not yet been selected; those two were dropped from the analysis, but still showed no significant association between action type and response (p-value = 1, n = 34).

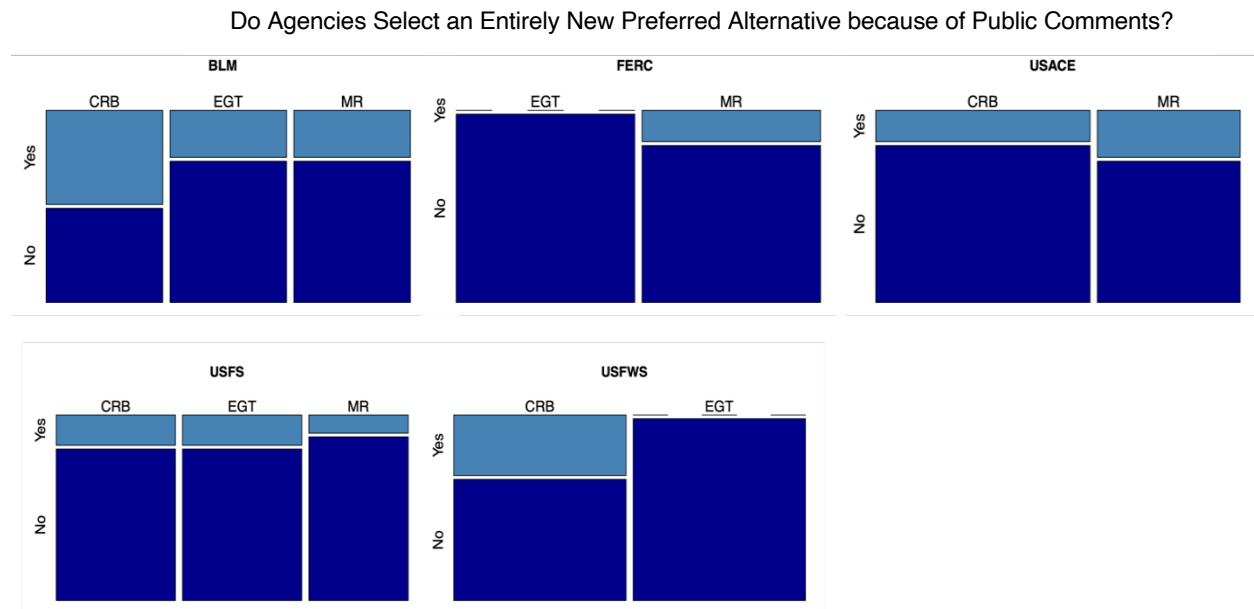


Figure 3 Do Agencies Select an Entirely New Preferred Alternative because of Public Comments? Grouped by agency, x axis represents agencies, y axis represents scale of each response (“Yes” or “No”).

A Fisher's exact test was then used to examine across all of the agencies within the same action type, if there is a significant association of a new preferred alternative being selected in response to public comment and the agency (Figure 4). No statistical significance between agencies and response was found in Conservation/Restoration/Biological Resource use projects (p-value = 0.33), Energy Generation/Transmission projects (p-value = 0.54), or Mineral Resource Extraction projects (p-value = 0.86).

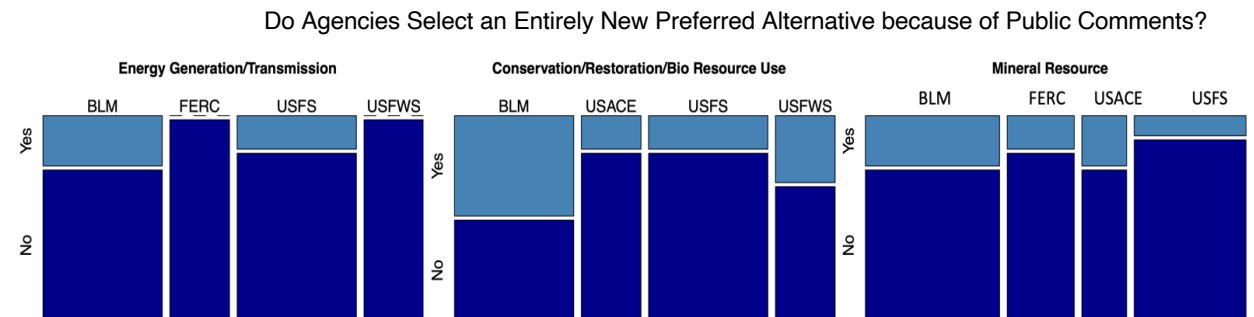


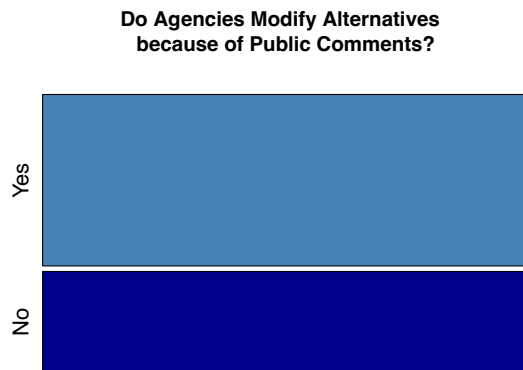
Figure 4 Do Agencies Select an Entirely New Preferred Alternative because of Public Comments? Grouped by action type, x axis represents agencies, y axis represents scale of each response (“Yes” or “No”).

*Consideration of Public Comments: Do agencies modify alternatives because of public comments? (Q2)*

Do Agencies Modify Alternatives because of Public Comments?			
Agency	Action Type	Yes	No
BLM	CRB	8	4
	EGT	8	4
	MR	7	5
FERC	EGT	2	4
	MR	5	1
USACE	CRB	3	3
	MR	6	0
USFS	CRB	4	8
	EGT	8	4
	MR	9	3
USFWS	CRB	5	1
	EGT	3	3

*Table 6 Do Agencies Modify Alternatives because of Public Comments? Total counts broken down by agency and action type, n = 108. (CRB = Conservation/Restoration/Bio Resource Use; EGT = Energy Generation/Transmission; MR = Mineral Resource Extraction)*

To answer our second research question, we tested whether the proportion of yes responses was greater than the proportion of no responses ( $H_0 = p_{Yes} > p_{No}$ ). We fail to reject the null hypothesis and conclude the proportion of yes responses to no responses is significantly greater (p-value = 0.9953, 95% CI = [0, 0.7063439]).



*Figure 5 Do Agencies Modify Alternatives because of Public Comments? Total count of "yes" and "no" responses, n = 108.*

*Does the frequency with which agencies modify alternatives (because of public comments) differ between agencies? (Q2a)*

A Fisher's exact test was used to determine across all of the action types within the agency, if there is a significant association of modifying alternatives in response to public comment across action types (Figure 6). There was not a statistically significant association between response and action type for BLM (p-value = 1), FERC (p-value = 0.24), USACE (p-value = 0.18), USFS (p-value = 0.17), or USFWS (p-value = 0.54).

Do Agencies Modify Alternatives because of Public Comments?



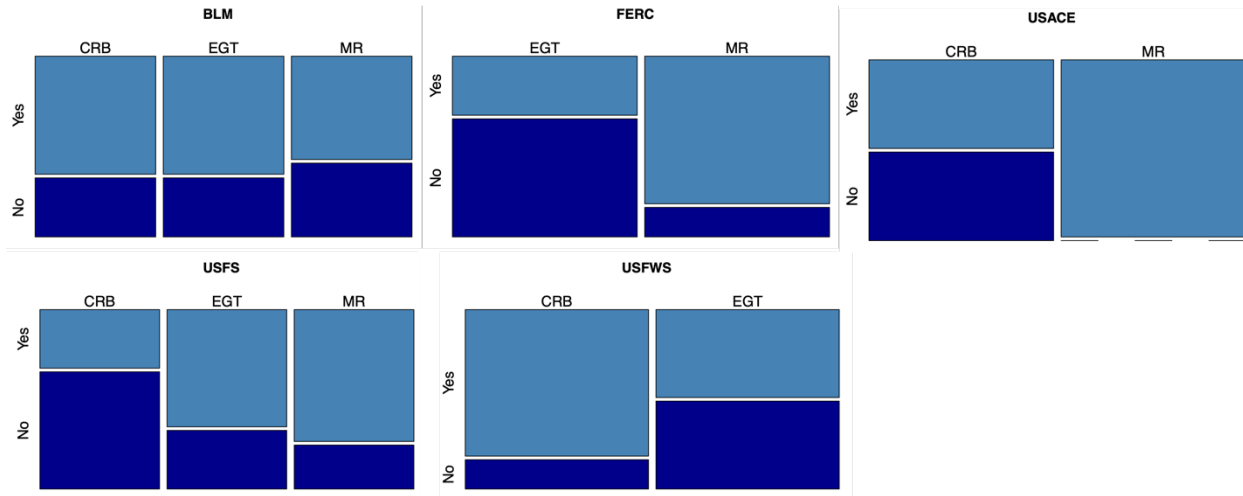


Figure 6 Do Agencies Modify Alternatives because of Public Comment? Grouped by agency, x axis represents action type, y axis represents scale of each response ("Yes" or "No").

Another set of tests were set up to examine all of the agencies within the same action type, and if there is a significant association between modifying alternatives in response to public comment and the agency (Figure 7). No statistical significance between agencies and response was found in Conservation/Restoration/Biological Resource use projects (p-value = 0.18), Energy Generation/Transmission projects (p-value = 0.50), or Mineral Resource Extraction projects (p-value = 0.36).

#### Do Agencies Modify Alternatives because of Public Comments?

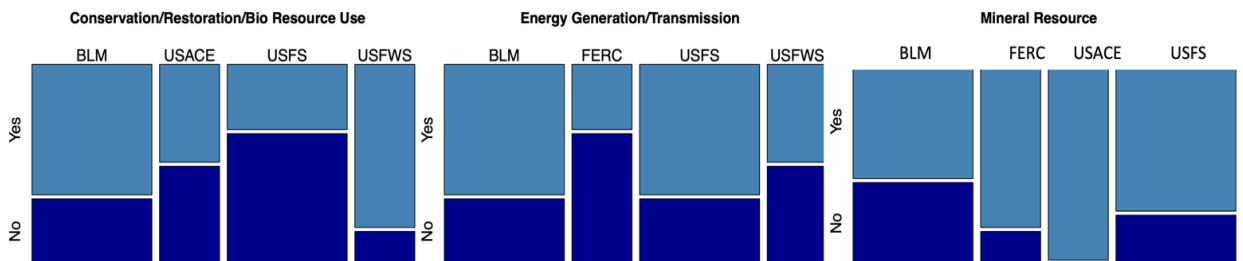


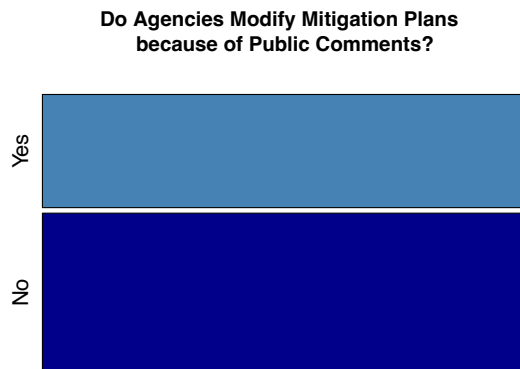
Figure 7 Do Agencies Modify Alternatives because of Public Comments? Grouped by action type, x axis represents agencies, y axis represents scale of each response ("Yes" or "No").

*Consideration of Public Comments: Do agencies modify mitigation plans because of public comments? (Q3)*

Do Agencies Modify Mitigation Plans because of Public Comments?			
Agency	Action Type	Yes	No
BLM	CRB	7	5
	EGT	6	6
	MR	2	10
FERC	EGT	4	2
	MR	5	1
USACE	CRB	0	6
	MR	5	1
USFS	CRB	4	8
	EGT	5	7
	MR	4	8
USFWS	CRB	2	4
	EGT	1	5

*Table 7 Do Agencies Modify Mitigation Plans because of Public Comments? Total counts broken down by agency and action type, n = 108. (CRB = Conservation/Restoration/Bio Resource Use; EGT = Energy Generation/Transmission; MR = Mineral Resource Extraction).*

To assess if agencies modify mitigation plans because of public comments, we tested whether the proportion of yes responses was greater than the proportion of no responses ( $H_0 = p_{Yes} > p_{No}$ ) using a proportion test. Based on the data, the results show borderline statistical significance that the proportion of yes responses is greater than the proportion of no responses. (p-value = 0.050, 95% CI = [0, 0.5004343]).



*Figure 8 Do Agencies Modify Mitigation Plans because of Public Comments? Total count of “yes” and “no” responses, n = 108.*

*Does the frequency with which agencies modify mitigation plans (because of public comments) differ between agencies? (Q3a)*

A Fisher's exact test was used to determine across all of the action types within an agency, if there is significant association between modifying alternatives in response to public comment across

action types (Figure 9). There was not a statistically significant association between response and action type for BLM (p-value = 0.11), FERC (p-value = 1), USFS (p-value = 1), or USFWS (p-value = 0.35).

For USACE projects, the data detects a significant association between alternatives being modified in response to public comment and action type (p-value = 0.015).

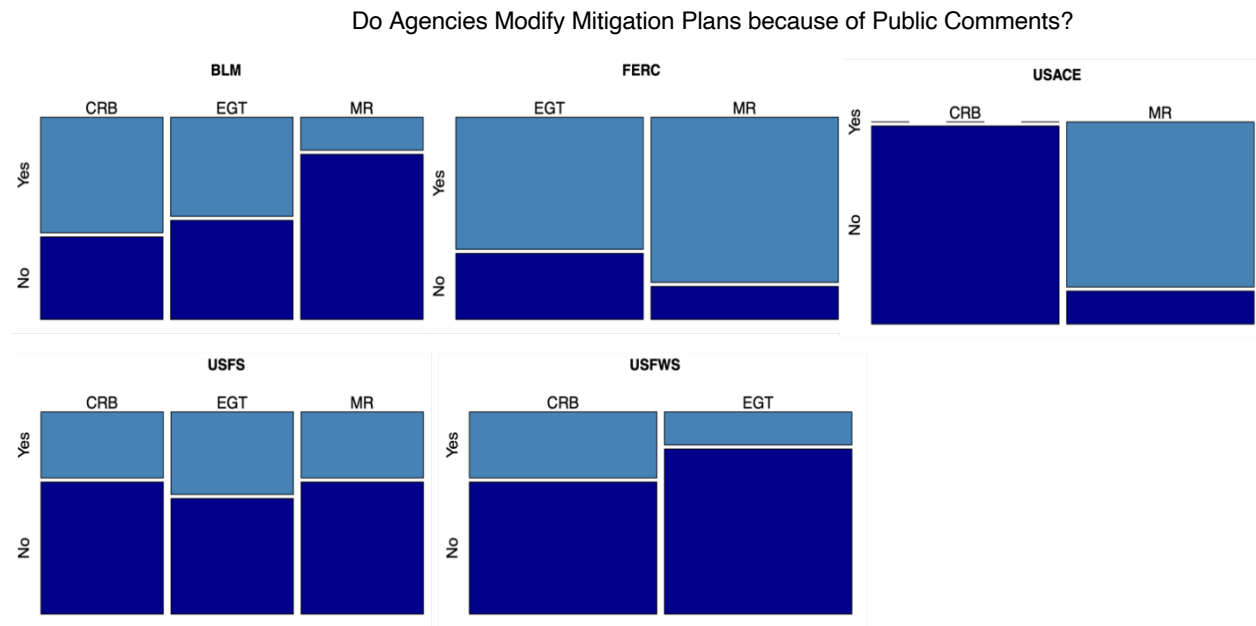


Figure 9 Do Agencies Modify Mitigation Plans because of Public Comments? Grouped by agency, x axis represents action type, y axis represents scale of each response (“Yes” or “No”).

The second set of tests were set up to examine all of the agencies within each action type, and if there is a significant association of modifying alternatives in response to public comment and agency (Figure 10). No statistical significance between agencies and response was found in Conservation/Restoration/Biological Resource use projects (p-value = 0.13) or Energy Generation/Transmission projects (p-value = 0.42).

Mineral Resource Extraction projects do show there is a significant association between the agency and mitigation measures being modified in response to public comments (p-value = 0.0088).

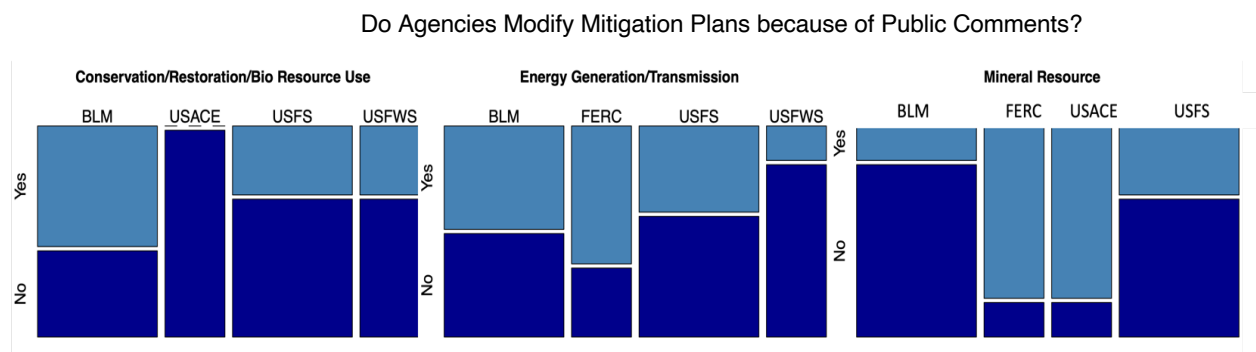


Figure 10 Do Agencies Modify Mitigation Plans because of Public Comments? Grouped by action type, x axis represents agencies, y axis represents scale of each response (“Yes” or “No”).

What elements of public participation are most influential? (Q4)

A PLS-LR was used to detect if any elements of public participation have more influence on an agency's decision to select a new preferred alternative, modify alternatives, or modify mitigation measures in response to public comments.

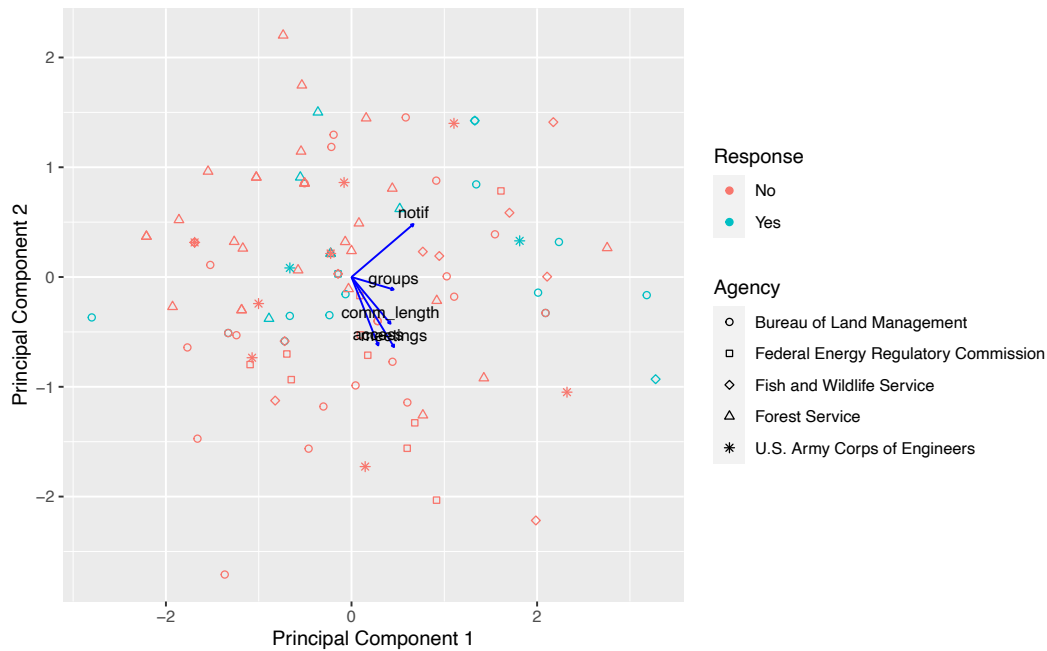


Figure 11 PLS-LR plot coded by color for response and shape for agency.



Figure 12 Figures 11 and 12 show the distribution of each observation, color coded by response and shape coded by agency (figure 11) and action type (figure 12). On the x-axis, the further to the right indicates increased comment period length,

notification efforts, number of meetings, accessibility and groups involved. Upward movement on the y-axis indicates shorter comment period lengths, fewer meetings, less accessibility, fewer groups involved, but more notification efforts.

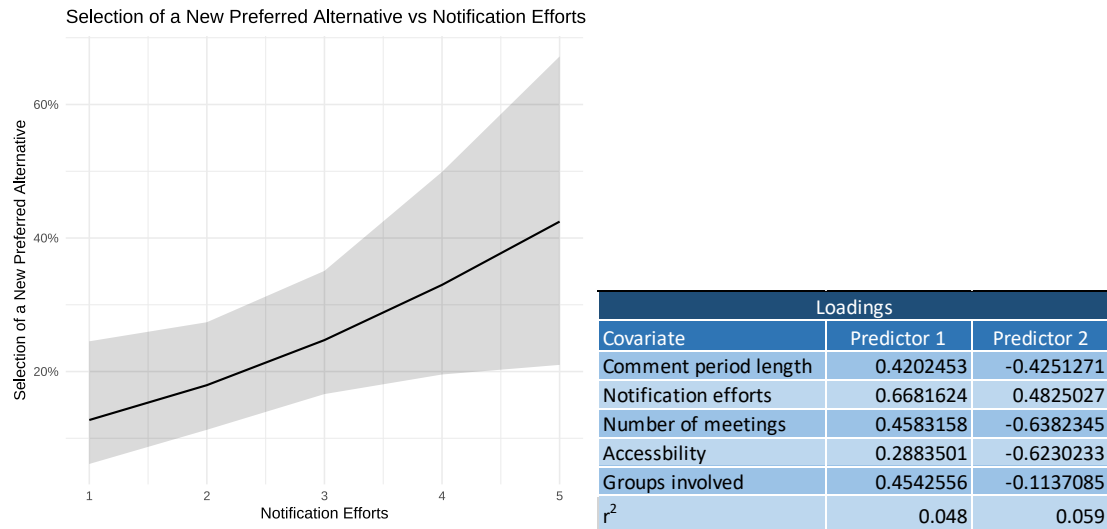


Figure 13 Selection of a New Preferred Alternative vs Notification Efforts

Table 8 Loadings for the two predictors.

Using the response data from the question “Is a new preferred alternative selected in response to public comment?”, and the recorded metadata from Table 3, we ran a PLS-LR to compress the five covariates (or elements of public participation) into two predictors. All five covariates were scaled to standardize the range of the continuous variables. Notification efforts were the most positively correlated with a new preferred alternative being selected. When looking at the two predictors, notification efforts contribute most to predictor 1, along with number of meetings, groups involved, and the comment length period having a positive effect on the selection of a new preferred alternative occurring. Apart from notification efforts, all other covariates have a negative effect on the selection of a new preferred alternative in predictor two. This model only explains a small amount of variation in the data (PC1:  $r^2 = 0.048$ ; PC2:  $r^2 = 0.059$ ).

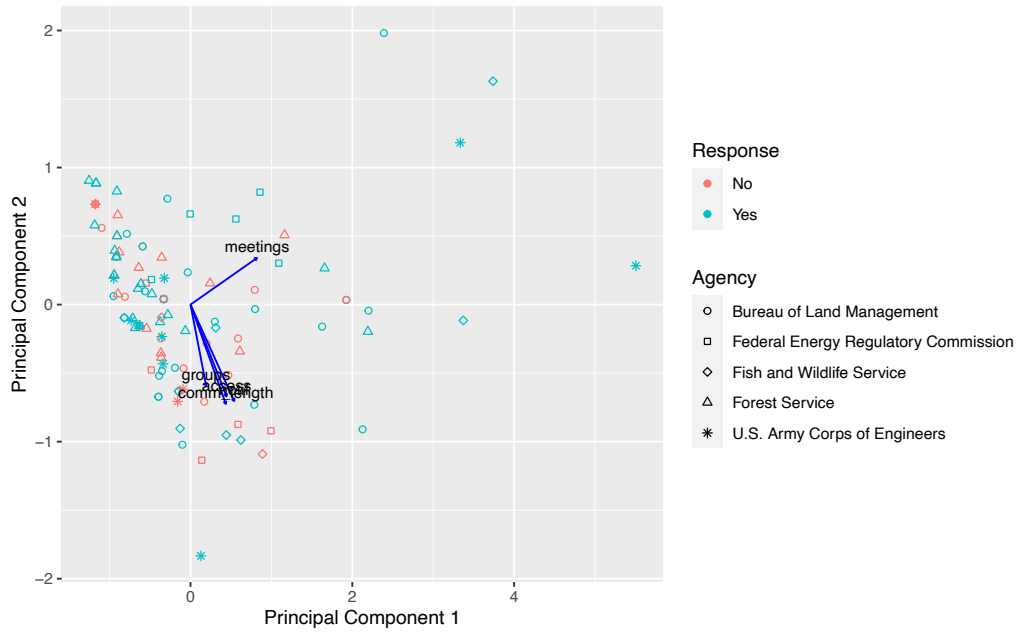


Figure 14 PLS-LR plot coded by color for response and shape for agency

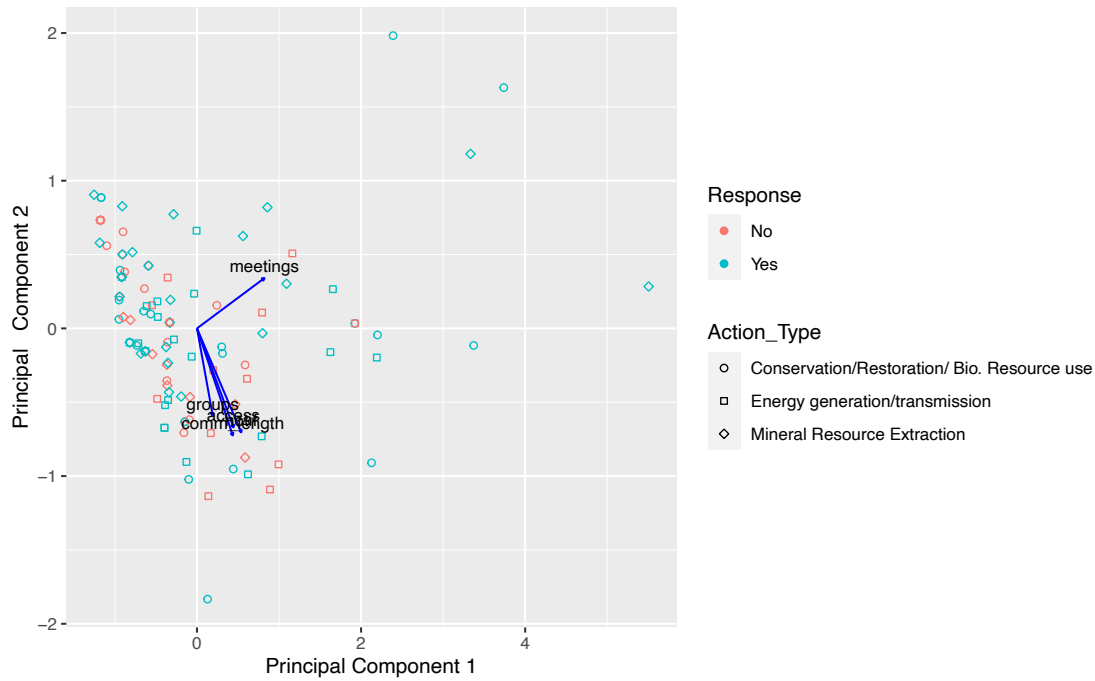


Figure 15 Figures 14 and 15 show the distribution of each observation, color coded by response and shape coded by agency (figure 14) and action type (figure 15). On the x-axis, the further to the right indicates increased comment period length, notification efforts, number of meetings, accessibility and groups involved. Upward movement on the y-axis indicates shorter comment period lengths, fewer notification efforts, less accessibility, fewer groups involved, but more meetings.

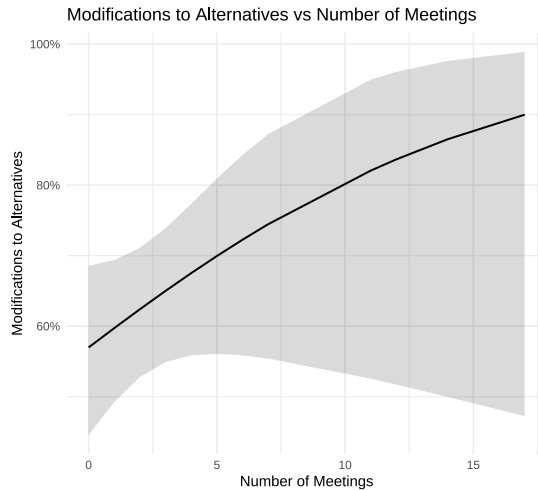


Figure 16 Modifications to Alternatives in Response to Public Comments vs Number of meetings

Loadings		
Covariate	Predictor 1	Predictor 2
Comment period length	0.4366457	-0.7246972
Notification efforts	0.5399567	-0.7040077
Number of meetings	0.8225992	0.3406771
Accessibility	0.4456297	-0.6701636
Groups involved	0.1928412	-0.5913380
$r^2$	0.015	0.026

Table 9 Loadings for the predictors

In the second PLS-LR, we used response data from the question “Are alternatives modified in response to public comment?” and the recorded covariate metadata. After scaling the covariates, our data show the number of meetings is most positively associated with alternatives being modified in response to public comments. Predictor 1 suggests more meetings, more notification efforts, more accessibility, and longer comment period lengths can lead to more modifications in alternatives occurring. Predictor 2 shows number of meetings having a positive effect on modifications of alternatives occurring, with all other covariates having a negative effect. However, this model explains a small amount of the variation in the data (PC1:  $r^2 = 0.015$ ; PC2:  $r^2 = 0.026$ ).

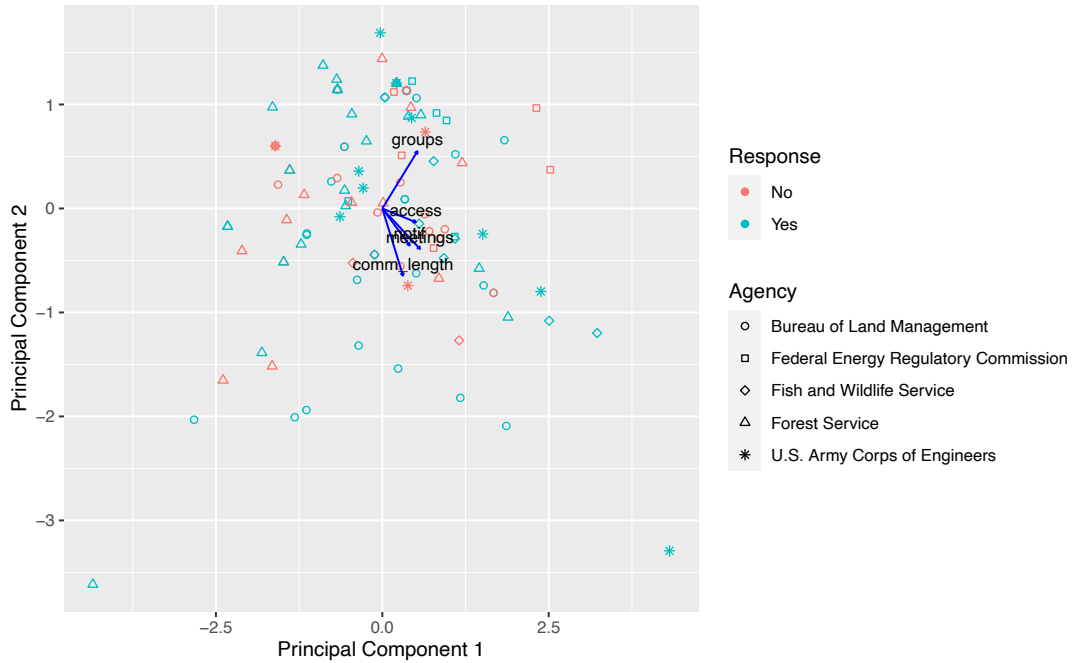


Figure 17 PLS-LR plot coded by color for response and shape for agency.

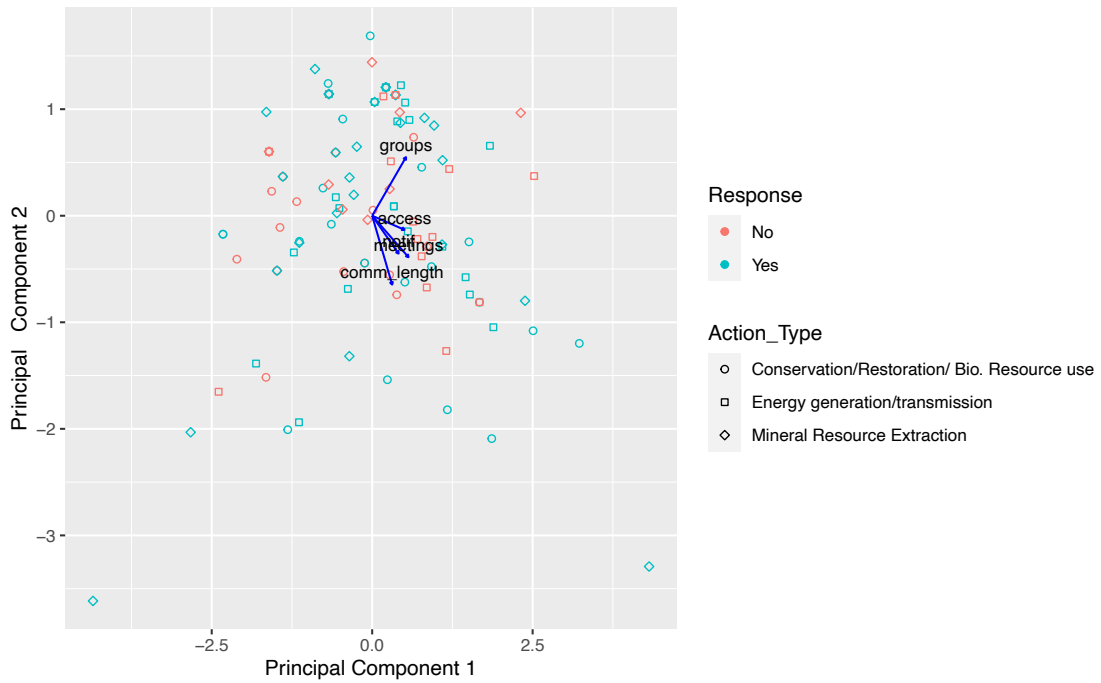


Figure 18 Figures 17 and 18 show the distribution of each observation, color coded by response and shape coded by agency (figure 17) and action type (figure 18). On the x-axis, the further to the right indicates increased comment period length, notification efforts, etc.



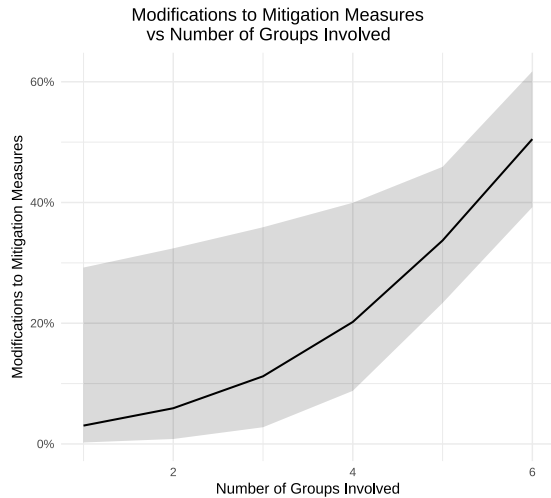


Figure 19 Modifications to Mitigation Measures in Response to Public Comments vs Groups Involved

Loadings		
Covariate	Predictor 1	Predictor 2
Comment period length	0.3111066	-0.6467446
Notification efforts	0.4116416	-0.3555458
Number of meetings	0.5663713	-0.3893800
Accessibility	0.5040651	-0.1320103
Groups involved	0.5275914	0.5499967
$r^2$	0.099	0.117

Table 10 Loadings for the predictors

The last PLS logistic regression used response data to the question “Are mitigation measures modified in response to public comment?” and the scaled covariate metadata. The model explains slightly more variation in the data compared to the first two regressions, with predictor one describing the number of meetings, groups involved, accessibility, notification efforts and comment period length as having a positive effect on the probability of modifications to mitigation arising (PC1:  $r^2 = 0.099$ ). Predictor two shows the comment period length, notification efforts, number of meetings and accessibility have a negative effect on the probability of modifications to mitigation occurring (PC2:  $r^2 = 0.117$ ). As the data shows, the number of groups involved has a positive effect in both components and is most positively associated with modifications being made to mitigation measures in response to public comments.

## Discussion

To investigate our first question (Do Agencies Select an Entirely New Preferred Alternative because of Public Comments?), we needed to know if the selection of an entirely *new preferred alternative* was in response to public comments. We hand coded each EIS process with a “yes” or “no” if language from the text suggested the new preferred alternative was selected in response to public comments and applied a proportion test. The results show that overall, agencies are not selecting an entirely new preferred alternative because of public comments.

To gain further insight, we asked the following question: Does the frequency with which agencies select an entirely new preferred alternative (because of public comments) differ between

agencies? (Q1a). We used a Fisher's exact test to test for a statistically significant association between agency, action type, and "yes" and "no" responses. We found there is not a significant association for any of the sampled agencies or action types. Based on the assumptions from the literature that agencies do not select an entirely new preferred alternative in response to public comments, we would expect there to be a significant association between agency, action type and the selection of a new preferred alternative in response to public comment. We would expect a negative association for both agency and action type, suggesting a new preferred alternative is not selected across agencies and action types. Within this study, we see instances of agencies selecting a new preferred alternative as well as not selecting a new alternative. Based on the proportion test, we conclude that "no" occurs more frequently than "yes", but we do not detect a significant association between agencies and the selection of an entirely new preferred alternative.

To answer our second question (Do agencies modify alternatives because of public comments?), we needed to know if alternatives were modified between the DEIS and FEIS in response to public comments. We hand coded each EIS process with a "yes" or "no" if language from the text suggested modifications to *alternatives* were in response to public comments and applied a proportion test to test if the proportion of "yes" responses was significantly greater than the proportion of "no" responses. The results show that agencies *are* modifying alternatives because of public comments more often than not.

To detect any significance between agency, action type, and whether or not alternatives were modified because of public comments, we used a Fisher's exact test to answer Q2a (*Does the frequency with which agencies modify alternatives (because of public comments) differ between agencies?*) We found there is not a significant association for any of the sampled agencies. This tells us that across the board, agencies are behaving similarly to one another, and the effect of action type or agency is not associated with changes to alternatives occurring, or not occurring. Based on the current perceptions of public participation from literature, we would expect there to be a statistically significant association between agency and a "no" response, suggesting that across agencies and action types, alternatives are not being modified in response to public comment-- our results imply this is not the case.

Although we do not see significant associations between agency or action type and the modifications of alternatives, we do see more instances of modifications to alternatives more frequently. Figure 2 shows the mosaic plots for changes to alternatives show that "yes" occurred more frequently in this sample than "no" (63% of all processes did undergo modifications to alternatives in response to comments). Therefore, we conclude that agencies do modify alternatives because of public comments.

To evaluate our third question (Do agencies modify mitigation plans because of public comments?), we needed to know if public comments from the DEIS review lead to modifications of mitigation plans in the FEIS. We hand coded each EIS process with a "yes" or "no" if language from the text suggested modifications to *mitigation* were in response to public comments and applied a proportion test. The null hypothesis of the test is that the proportion of "yes" responses is greater than "no" responses. The results show marginal significance, with a p-value of 0.05 at a significance level of 0.05. Figure 8 shows the proportion of "yes" to "no" responses for the respective question. As shown, the proportion of each response is much more equal compared to our first two questions, with a total count of 45 "yes" responses, and 64 "no" responses (n = 108). Based on our data, there is no strong

evidence that “yes” is greater than “no”, or vice versa. We conclude from these results that agencies are just as likely to modify or not modify mitigation plans because of public comments.

A Fisher’s exact test was used to answer question 3a: Does the frequency with which agencies modify mitigation plans (because of public comments) differ between agencies? This tested for a statistically significant association between agency, action type, and modifications of mitigation plans because of public comments. We found for all action types under BLM, FERC, USFS, and USFWS there is not a statistically significant association. However, projects done by USACE show a significant association between action type and modifications being made to mitigation. This significance could be attributed to conservation/restoration/ biological resource use projects carried out by the USACE—there we no recorded instances where mitigation measures were modified in response to public comments (n = 6). The results for an association between agencies within a certain action type show that agencies carrying out mineral resource projects do show a significant association. Particularly, we can see in figure 10 that FERC and USACE have more occurrences of modifying mitigation plans (“yes”) versus not modifying mitigation plans in response to public comments (“no”) when carrying out a mineral resource extraction project. This could contribute to the significant result, implying FERC and USACE are positively associated with modifications to mitigation occurring in response to public comment.

The borderline significance from our proportion test is further explained by the fisher’s exact test results. We can see that there is a difference among agencies and action types, and whether modifications to mitigation plans occur. We conclude that USACE does not modify mitigation plans for conservation/restoration/bio resource use projects because of public comments. However, BLM, FERC, USFS, and USFWS do modify mitigation plans because of public comments. The data also shows that there is a significant association of certain agencies within mineral resource extraction projects and modifications to mitigation plans occurring. These results show that the incorporation of public comments into mitigation plans depends on the agency as well as the action type.

The results from the three partial least squares logistic regressions (PLS-LR) help us understand if any elements of public participation are heavily associated with the selection of a new preferred alternative, modifications of alternatives, or modification of mitigation measures in response to public comments. The data moderately suggests that notification efforts, number of meetings, and types of groups involved may lead to a new preferred alternative being selected, modifications being made to alternatives, or modifications being made to mitigation, respectively. Although the models do not explain a significant amount of variation in the data, there are some trends we can identify.

Figures 11-12, 14-15, and 17-18 do not show any prominent clustering of observations but do show interesting patterns in outliers. On Figures 14-15, several of the outliers are “yes” responses, whereas “no” responses tend to be distributed over a slightly smaller range. Other than these outliers, there were no other indications the recorded elements of public participation are strongly associated with changes being made. We assume these drivers occur outside of the public participation process. More information is needed to understand when and why agencies modify plans and select a new preferred alternative.

There are two points in the EIS process where the public has the opportunity to engage with the agency and provide feedback, comments, and concerns. This occurs prior to drafting the EIS, known as scoping, and during the DEIS review phase—which is the point in the process we examined. CEQ

regulations require agencies to include all comments received as well as the agency's responses, but this is not a requirement for scoping. Because of this, scoping metrics are underreported, and in some cases, not reported at all. Project websites have been used to publish this information, along with other documents such as technical reports, location information, and raw data. However, these websites only stay active for a few years after the project is completed, and this information is lost as it is not archived publicly. Access to this information is crucial to assess how scoping influences the EIS process. Without knowing the concerns that were raised or how the agency responded or incorporated these into the decision is unknown. Our data suggests the drivers behind an agency selecting a new preferred alternative, modifying alternatives, or modifying mitigation is outside of the scope of the data collected in this study. Comprehensive coverage of scoping information could illuminate if these drivers to change lie here.

Emerson et al. (2022) suggest accessibility and engagement with the proper communities is an important mechanism of public participation. From our observations, agency efforts to engage with low-income and minority communities should be improved. Only four out of the 108 documents reported additional outreach efforts to environmental justice communities. Offering a virtual option for meetings, ensuring meetings are outside of normal working hours and central to the affected area, and providing information in multiple languages can improve access for low-income and minority communities. Ensuring all affected communities have sufficient opportunities to engage in the process can further the impact of public participation.

## **Conclusion**

Public participation is a crucial element of democratic governance, ensuring that governmental decisions reflect the people's interests, particularly in environmental policymaking. NEPA was created to exemplify this exact idea—when the public is involved in a process, better social and environmental outcomes are possible. Until recently, the impacts of public participation have been unknown, but highly theorized. This study sought to understand how public participation is impacting the EIS process, and what elements of public participation are most influential. We discovered that although agencies may not select an entirely new preferred alternative because of public comments, comments are considered and lead to the modification of alternatives and mitigation plans. Further research is needed to understand exactly why public participation influences outcomes. Understanding when, how, and why public participation has an impact on federal decisions fosters transparency and ensures the inclusivity of all stakeholders.

## APPENDIX

### Appendix A: 2023 NEPA Phase 2 Regulations Public Comment Letter

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Sep 28, 2023

Council on Environmental Quality

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Washington, D.C. 20503

docket number CEQ-2023-0003

Dear Council On Environmental Quality,

On behalf of the NEPAAccess team ([nepaccess.org](http://nepaccess.org)), I am writing to provide our comments and recommendations regarding the National Environmental Policy Act Implementing Regulations Revisions Phase 2. These comments seek to improve effectiveness, accountability, and transparency within the NEPA process with regards to public engagement.

I am a graduate student in the School of Natural Resources and the Environment at the University of Arizona and a researcher on the NEPAAccess team. My comments are based on research conducted with the NEPAAccess platform, including an analysis of 216 draft and final environmental impact statements covering a 16-year time span (2003-2019).<sup>1</sup>

The signing of NEPA in 1970 was influenced by a series of environmental disasters and growing concerns from the public about environmental degradation. While NEPA itself did not directly result from specific disasters, it was shaped by the overall environmental consciousness of the era. NEPA was ahead of its time in 1970, lacking the tools to achieve its grand ambitions. The 21st century revolution in data science can bring NEPA into its own.

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<sup>1</sup> Stava et al., "The Impact of Public Comments: A Quantitative Study of Public Engagement in the NEPA Process," manuscript in preparation.

Public engagement plays a pivotal role in NEPA as it fosters a democratic decision-making process in environmental matters. Public engagement ensures that diverse perspectives and voices are heard, contributing to well-informed and balanced environmental policies. Our team recently published a paper that provides a framework for assessing the environmental impact review process and, subsequently, the nature of public engagement.<sup>2</sup> Without adequate reporting of public engagement methods and other metadata, we cannot determine the influence of the public on the NEPA process.

To understand better current public engagement practices and its impact on the environmental decision-making process, we recommend the following additions to the NEPA Implementing Regulations Revisions Phase 2:

### **1) Track Public Engagement**

Our research underscores the importance of methodically documenting public engagement in the decision-making processes. Further, shedding light on the methods of outreach not only enhances transparency but also mirrors best practices.

#### Recommendations:

- Incorporate a systematic record of public engagement metadata within documents.
  - Agencies should report the number of meetings held, attendees present, comments received, means of notification, length of commenting periods, types of groups involved, and accessibility of meetings (times held, childcare available, video streaming, etc.). This should be included in a clearly labeled appendix.
  - Include every public comment from scoping and Draft EIS review (in full, not just summaries), coupled with agency responses in an appendix.

### **2) Improve Efforts to Engage with the Public**

To promote transparent and inclusive public engagement, agencies should expand their communication with the public beyond notices in the Federal Register. Such strategies are supported by other researchers who argue for diversifying outreach avenues.<sup>3</sup> This stance champions the ideals of fostering equity in public engagement.<sup>4</sup>

#### Recommendations:

- Notices regarding public meetings and the availability of documents should extend to online platforms, local newspapers, radio, television spots, and even direct mail to individuals in the affected area.

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<sup>2</sup> Emerson, K., Baldwin, E., Scott, TA., JR Pidot, AM Lien, F Currim, S Bethard, S Ram, ML Miller, & L López-Hoffman. (2022). Toward NEPA performance: A framework for assessing EIAs. *Environmental Impact Assessment Review* 97: 106879.

<sup>3</sup> Rowe, G., & Frewer, L. J. (2000). Public participation methods: A framework for evaluation. *Science, Technology, & Human Values*, 25(1), 3-29.

<sup>4</sup> Mohai, P., Pellow, D., & Roberts, J. T. (2009). Environmental justice. *Annual Review of Environment and Resources*, 34, 405-430.

<sup>5</sup> Schlosberg, D., & Collins, L. B. (2014). From environmental to climate justice: Climate change and the discourse of environmental justice. *Wiley Interdisciplinary Reviews: Climate Change*, 5(3), 359-374..

- Agencies should provide guidelines for additional engagement efforts for marginalized communities and those affected by environmental justice.
- Documents should include geospatial data in the form of polygons for project areas and the affected environment, while also incorporating geospatial metadata fields like coordinates and location tags to ensure the entire affected population is included in the engagement process. These polygons should be provided in an open Geographical Information System (GIS) format such as GeoJSON.
  - AECOM's PlanEngage is a good example of a digital tool that enhances the public accessibility and interactivity of environmental data. Ideally, CEQ would recommend an open-source tool like PlanEngage to increase engagement, expedite project permitting, and enhance environmental and social results.

### **3) Utilize a Single, Unified Platform to Engage the Public**

To further improve the effectiveness of public engagement, a single platform shared across agencies where the public can access environmental documents and directly engage in the process can greatly increase effectiveness, accountability, and transparency in the NEPA process.<sup>5</sup>

#### Recommendations:

- Agencies should cease using impermanent, project-specific websites and endorse a single platform to post notices, EIS/EA/CEs, and all accompanying documents.
  - Such a platform would allow the public to gather information, directly submit comments, view old processes as well as current processes, and be notified of any processes occurring in their area.
  - A single platform would help expedite and organize the comment and response process for agencies.
- There should be a standardized format for documents.
  - Section titles within EISs should follow a standard set of canonical CEQ section titles (which should appear in a fixed order) and include a glossary. This standardization is critical to machine readability (improving machine learning capabilities).

### **4) Evaluate the Impact of Public Engagement**

Public engagement is the cornerstone of NEPA, improving and expanding on engagement methods is crucial to understanding the effectiveness of NEPA. Our research demonstrates that having data on public engagement yields invaluable perspectives on its influence over agency decisions. Such insights are pivotal for informed policymaking. Mandating agencies to clearly annotate changes made to strategies or final decisions, in light of public feedback, harmonizes with the recommendations of others for an emphasis on transparency and accountability.<sup>6</sup>

#### Recommendation:

- Require agencies to plainly attribute how changes in documents and decisions reflect information and insights gathered from the public, including: changes to

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<sup>6</sup> Schmidt, A. M., & Grimmelikhuijsen, S. G. (2012). Does transparency strengthen legitimacy? Evaluating the role of transparency in third-party perceptions of fairness and legitimacy. *Public Administration Review*, 72(6), 786-795.

<sup>7</sup> Beierle, T. C., & Cayford, J. (2002). *Democracy in practice: Public participation in environmental decisions*. Resources for the Future.



alternatives, site location, mitigation, impacts, or selection of the preferred and environmentally preferred alternative.

We applaud CEQ for its endeavors in modernizing NEPA regulations. Our recommendations for data science best practices are geared towards improving the environmental review process by promoting effectiveness, accountability, and transparency, which will ultimately equip NEPA to become the vital force for democratic governance it was intended to be.

Thank you.

Sincerely,

Ashley Stava

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