

Sample Engineering Case Study Elevation

Introduction

In an effort to improve the quality of project applications, engineering case studies have been prepared for several common mitigation measures. The engineering cases studies provide focus on the types of information and data needed to ensure completeness of the sections of the project application affecting engineering feasibility. Of particular importance in the engineering review are:

- Scope of Work, including:
 - Problem Description and Proposed Solution;
 - Description of Existing Condition; and,
 - Work Schedule.
- Cost Estimate, including:
 - Conducting the Benefit-Cost Analysis;
 - Anticipated environmental resource remediation or historic property treatment measures;
 - Engineering schematics, detailed engineering drawings, or engineering designs;
 - Other related construction/demolition/relocation costs, such as survey, permitting, site preparation, material disposal; and,
 - Other related acquisition costs, such as appraisals, legal recordation, displacement costs for renters, maintenance.

For each of these sections in the project sub-application, the engineering case studies describe the general type of information that a Sub-applicant should submit. In order to provide additional guidance, the case studies also include sections of a sample project application that present the kind of specific information that the Sub-applicant would need to include in each engineering-related section to support the proposed project. These engineering case studies are not meant to represent complete project applications. Some relevant project information related to historic and environmental impacts, as well as information regarding the project's cost effectiveness may not be included.

One of the most common mitigation methods is to elevate a flood prone structure so that First Floor Elevation (FFE) is above a desired design flood elevation (DFE). When the property falls within a FEMA designated Special Flood Hazard Area (SFHA), the DFE is commonly established by the Base Flood Elevation (BFE), which is determined from the FEMA Flood Insurance Study (FIS). The goal of these projects is to elevate all living or occupied space above the level of all but the most severe flood events. This can be accomplished by a number of methods including elevating the entire structure on the existing foundation, constructing a new structural foundation, or abandoning living space below the DFE and replacing it with new construction at a higher elevation. Although many of these methods can vary significantly in approach, the general information required for a complete grant application is fairly similar. The following sections describe in detail the information required, and provides samples for each application section.

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Scope of Work

The proposed elevation activities should be well defined and technical documentation should be provided verifying that the scope of work will successfully protect the structures against future flood damages up to the design flood elevation. Detailed technical information should be provided in the scope of work description, including the following.

- Describe the elevation technique being employed for each structure to be elevated.
- If possible include calculations for all applicable loads (live, dead, lateral, soil, wind, flood and scour) particularly for structures in SFHA V zones.
- Describe the new foundation type. Show pile or pier configuration, loads and connection details.
- State what elevation the first floor of the structure will be raised to, and its relation to the BFE and/or storm surge elevations.
- Show that all NFIP requirements have been addressed.
- Include any Federal, State or Local building codes or standards that need to be followed (e.g. FEMA 347).

Example Scope of Work

The elevation of all 11 projects included in this project application will be completed so that the FFE of each structure is one foot above the BFE. As stated above, the BFE throughout the project area is 9 feet NGVD. Therefore all properties included in this project will be elevated to a minimum elevation of 10 feet NGVD. As a condition of being included in the project application, property owners were required to submit conceptual design documents prepared by a qualified structural engineer. Because all structures are currently constructed on a crawl space, all projects will be completed by elevating the structure, constructing a new pier foundation, and placing the structure on the newly constructed foundation. Detailed descriptions of the foundation design for each structure, including site schematic drawings and structure photos have been included as an attachment to this application. All NFIP codes and standards will be incorporated into the project design, and will be enforced by the County Building Department. The work will be completed by the lowest competitive bid from a local qualified construction firm.

Problem Description and Proposed Solution

A detailed written description of the history of flooding that has occurred at the project location should be provided and should include the following information.

- Describe in detail the source of flooding (e.g. riverine, coastal, local drainage, etc.) and provide any explanation of the cause of flooding. (e.g. pre-FIRM construction, increased upstream development, inadequate drainage capacity of flooding source, etc.)
- List the history of previous flood events including dates, extent and magnitude of impacts, photos of historic flooding, overall cost of damages, and the estimated frequency of each specific event.

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- If the facility is in a FEMA Special Flood Hazard Area (SFHA), list the corresponding flood depths and discharges from the Flood Insurance Study (FIS) for the various storm recurrence intervals.
- Briefly state the proposed solution, which will be described in detail in the scope-of-work section.

Example Problem Description and Proposed Solution

The Suburban residential neighborhood has experienced frequent and significant flooding since its development in the late 1950's. The Suburban neighborhood is bounded by the Bay on the east and south, by 1st Avenue on the west, and by Main Street on the north. A detailed map of the area, as well as a map depicting its location within the community, has been attached.

Minor flooding in this area occurs on a nearly annual basis, while significant flooding has occurred approximately 6 times since it's development in the late 1950's. The last significant flood event occurred on September 6th and 7th of 1999, when floodwaters associated with Tropical Storm ABC reached an elevation of 9.1 feet National Geodetic Vertical Datum (NGVD) in the Bay. Over 30 structures in the area were inundated with floodwaters due to this event, with some receiving up to 3 feet of floodwaters in the first floor of the structure. The elevated waters cut off access to the neighborhood for over 2 days and some families were not able to return to their homes for up to three weeks. The total damage from Tropical Storm ABC, in the Suburban neighborhood alone, was over \$1 million dollars. The attached spreadsheet titled "Suburban Damage History" includes a record of all recorded flood events in this area, and includes the date of the event, maximum flood elevation, estimated return frequency, number of structures impacted, average damage per structure, and total damage in the neighborhood.

There are approximately 60 residential properties located within this area, virtually all of which have experienced flooding during moderate to significant coastal storms. The average grade elevation in the area is approximately 6 feet NGVD. With no seawall or other flood protection structure, floodwaters enter the neighborhood when the tide elevations in the Bay exceed the grade elevation. According to the FEMA Flood Insurance Study for the community, completed in 1992, the entire project area is located in a SFHA Zone A, with a BFE of 9 feet NGVD. The table of flood frequencies and corresponding tide heights for the Bay have been included as attachments to this application.

This project proposes that 11 of the residential structures located in the impacted area of the Bay be elevated so that the FFE of each structure is one foot above the BFE of 9 feet NGVD.

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Description of Existing Conditions

The facility(ies) being elevated should be listed. The following information should be included in the property description of the application:

- List the number of properties or facilities that are being elevated.
- Describe the primary use of the facilities (e.g. single family residential, public library, commercial).
- If residential, state if the property is owner-occupied, rental or seasonal.
- Provide a detailed description of the facility including: foundation type (e.g. slab-on-grade, crawl space, underground basement), construction type (e.g. wood frame, masonry, concrete), square footage, age, value of structure, condition, first floor elevation (elevation certificate), etc.
- List the damages that have occurred to the facility for various storm events and the costs associated with those damages. Include a history of flood insurance claims made for each property if possible.
- If the property is commercial or industrial, the owner must provide information identifying what, if any, hazardous materials are known to exist within the facility that may require special handling or measures (e.g. fuel tanks, etc.).

Example Description of Existing Conditions

There are 11 residential structures located in the impacted area of the Bay that are proposed to be elevated. The locations of the 11 homes are indicated on the community street map enclosed with the application. Eight of the homes are owner-occupied, two are rental properties, while one is a seasonal property. All of the structures are wood frame construction with a crawlspace built in the late 1950's. The average grade elevation of the homes included in the elevation project is approximately 6 feet NGVD. A property list is attached including the property type (residential, non-residential), construction date, photo of each structure, value of structure (obtained from County Clerk and Recorder's Office property records); and Finished Floor Elevations (FFE) for each structure. In addition, a copy of the tax assessor's sheet for each property and a FEMA-approved elevation certificate for each structure have been included. The Elevation Certificates have been prepared prior to the submission of this application by the County survey crew.

Work Schedule

Additional supporting documentation should include a work schedule to:

- Describe the anticipated project schedule.
- Include all phases of the task including: survey, design/specifications, construction, permitting, site preparation, etc.

Example Work Schedule

The anticipated project schedule for the proposed project is included below. This schedule has been prepared for a typical structure included in this application. The schedule for each individual property may vary based on site specific conditions. The complete elevation program will be completed within 18 months of project approval.

Description of Task Starting Point Unit of Time Duration Unit of Time

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<i>Property Survey</i>	<i>0</i>	<i>Month</i>	<i>1</i>	<i>Months</i>
<i>Bid Proposal and Award</i>	<i>1</i>	<i>Month</i>	<i>3</i>	<i>Months</i>
<i>Permitting and Contracting</i>	<i>4</i>	<i>Month</i>	<i>2</i>	<i>Months</i>
<i>Site preparation</i>	<i>6</i>	<i>Month</i>	<i>1</i>	<i>Months</i>
<i>Elevation</i>	<i>7</i>	<i>Month</i>	<i>4</i>	<i>Months</i>
<i>Site grading and Landscaping</i>	<i>11</i>	<i>Month</i>	<i>1</i>	<i>Months</i>

Cost Estimate

- Make sure all anticipated elevation project costs are detailed.
- Provide the source of the estimate (e.g. documented local cost, bids from qualified professionals, published national or local cost estimating guides, etc.)
- Consider the potential future date of construction when compiling the cost estimate.

Example Cost Estimate

Actual construction estimates have been completed for each structure included in the project application. Property owners have been required to submit a cost estimate, completed by a qualified structural engineer prior to inclusion in the program. Detailed summaries of the cost estimates have been included in the Project Cost Summary Table attached. In addition, copies of the cost estimate provided for each structure have also been included. Based on the cost estimates provided, the total project cost for this project is \$528,000, with a federal share of \$396,000.