

# Estimating the Value of Partner Contributions to Flood Mapping Projects “Blue Book”

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**FEMA**



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## Approvals

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## Table of Contents

1.	Background .....	1
2.	Purpose .....	1
3.	Overview of Approach .....	2
4.	Federal Matching Programs .....	3
5.	Methodology .....	3
6.	Unit Costs .....	4
7.	Definitions .....	6

## List of Tables

Table 1.	Unit Cost Factors .....	4
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## 1. Background

In 1997, the Department of Homeland Security's Federal Emergency Management Agency (FEMA) created a Flood Map Modernization (Map Mod) plan to modernize the flood hazard mapping effort and eliminate the backlog of outdated flood hazard maps. One of FEMA's key goals for Map Mod was to increase local involvement in the development and long-term maintenance of its flood hazard maps. To meet this long-standing objective, FEMA created the Cooperating Technical Partners (CTP) program. The CTP program allows communities, tribal nations, regional agencies, universities, and State agencies that have the interest and capability to become active partners in FEMA's flood hazard mapping effort. To date, over 246 partners have entered into formal agreements with FEMA to provide specific contributions to the flood hazard mapping effort for their communities. Through these partnerships, local knowledge and expertise are incorporated into the flood hazard maps, and partners' contributions are maximized to leverage Federal funding to the fullest extent possible, while consistently maintaining national standards.

To leverage the successes of Map Mod and further enhance the usability and value of flood hazard mapping, FEMA developed the Risk Mapping, Assessment, and Planning (Risk MAP) strategy. Risk MAP combines flood hazard mapping, risk assessment tools, and mitigation planning into one seamless program. The intent of this integrated program is to encourage beneficial partnerships and innovative uses of flood hazard and risk assessment data to maximize flood loss reduction. As FEMA moves forward with the Risk MAP implementation, the CTP program will continue to be an essential component.

FEMA has been tracking the extent to which its mapping funds have been leveraged through the CTP program since the first partnership agreements were signed in 1999. To estimate each partner's contribution to ongoing mapping activities, FEMA has applied a series of unit costs that are indicative of FEMA's costs to produce a National Flood Insurance Program (NFIP) map. Although leverage of studies is generally associated with the CTP program, other partners who are not members of the CTP program can provide FEMA with flood mapping-related data and thus leverage their data.

## 2. Purpose

The purpose of this document is to outline the unit-cost approach FEMA uses in estimating the value of mapping activities contributed by communities, tribal nations, regional agencies, universities, and State agencies for updated Flood Insurance Rate Map (FIRM) production.

The unit-cost approach described in this document should only be used to determine the value of a partner's contribution. Because the actual costs associated with individual projects may vary significantly, **under no circumstances should these unit costs be used to estimate the cost of individual projects**. Resources are available through FEMA's Regional Offices to assist in

estimating the cost of individual projects. Please contact the appropriate FEMA CTP Regional Coordinator for more information ([http://www.fema.gov/plan/prevent/fhm/ctp\\_key.shtm](http://www.fema.gov/plan/prevent/fhm/ctp_key.shtm)).

The Blue Book is a living document. Because of changing conditions in technologies, processes, and the economy, this publication will be evaluated each fiscal year and FEMA will determine whether revisions are warranted.

### 3. Overview of Approach

FEMA documents the contributions of its mapping partners (primarily participants in the CTP program) by estimating the value of their contributions to the production of their flood hazard maps. The approach for evaluating partner contributions was originally developed for the CTP program by way of leveraged activity. This approach includes estimates of each partner's contribution to ongoing mapping activities and the overall value of the partner's mapping efforts relative to FEMA's investment in these mapping activities. The methodology uses a series of unit costs and applies them to the number of work units (i.e., linear miles of study) to estimate the value of various project elements in the map-production process.

FEMA developed these unit costs to ensure that the value of each map product reflects only the costs typically incurred by FEMA to produce them. Partners may choose to incur costs above and beyond what FEMA would normally expend for the same activity, and these additional costs should not skew the estimate of the project's value to FEMA. For example, a partner that plans to use the topographic data for additional purposes may choose to include data and information that FEMA would not normally include. Accordingly, the cost to collect and process such data should not be considered when evaluating the value of the topographic data.

Moreover, by using uniform unit costs, the value of partnering with communities, tribal nations, regional agencies, universities, and State agencies can be estimated at any stage of a mapping project. FEMA can determine the extent to which it is leveraging Federal funds while projects are ongoing. This would not be the case if actual costs were used, because the full costs would not be known until the project is complete. For example, although a preliminary digital FIRM (DFIRM) may have already been produced by a partner, the costs incurred will likely change as a result of appeals and/or protests.

FEMA intends to use the unit-cost approach (or this Blue Book) to estimate only those partner contributions that will lead to the production of new or updated DFIRMs. To be used and given credit, products submitted by partners must meet the requirements of FEMA's current *Guidelines and Specifications for Flood Hazard Mapping Partners* ([http://www.fema.gov/plan/prevent/fhm/gs\\_main.shtm](http://www.fema.gov/plan/prevent/fhm/gs_main.shtm)). If data are submitted that do not meet the requirements of FEMA's current *Guidelines and Specifications for Flood Hazard Mapping Partners*, the contribution may be devalued based on additional costs incurred by FEMA to bring those data up to specifications.

Unit costs have been developed for the following mapping project elements:

- Discovery
- Risk Communication and Outreach
- Field Surveys
- Topographic Data Development
- Base Map Preparation
- Enhanced Study (Detailed Riverine\*)
- Enhanced Study (Limited Detail Riverine\*)
- Perform Coastal Analysis
- Detailed Alluvial
- Base Study (Approximate Analysis\*)
- DFIRM Production, Distribution, and Finalization
- Non-Regulatory Flood Risk Products

\*Previous designation for study type

## 4. Federal Matching Programs

The Federal government has several matching grant programs available to partners in which the government and the partner each agree to fund a certain percentage of the total cost of a given project. In these cases, when a Federal financial contribution is met by a matching (whole or partial) financial contribution from the partner, and those monies are used to accomplish a flood mapping task, FEMA will evaluate the percentage of the unit cost attributed to the task that will be credited to the partner. The partner will not receive 100 percent of the credit for that task unless the task is completely non-Federally funded. For example, a Federal agency and the partner may participate in an 80/20 grant program, where the Federal agency funds 80 percent of the project and the partner funds 20 percent of the project. In this example, the project entails completing field surveys for X miles. FEMA would consider the partner's leverage to be 20 percent of the unit cost for X miles of the field-survey activity. For the purposes of the CTP program and leverage calculations for all mapping partners, only the 20-percent match would be credited for leverage.

## 5. Methodology

FEMA's Blue Book was first published in 2002. The unit costs in the original version of the document were developed from FEMA's Mapping Needs Update Support System. In 2003, these unit costs had to be adjusted for inflation. An inflation rate of 2.2 percent was assumed and used to update the unit costs. The Blue Book was updated again in 2006. The 2006 update was based on the availability of additional cost data and was not merely an adjustment for inflation. For the 2009 update, new unit costs were developed for the Topographic Data Development and Perform Coastal Analysis mapping project elements. For the current update, input on new units and the corresponding costs was collected from FEMA Headquarters, 10 FEMA Regional offices, FEMA's Program Management contractor, and the Production and Technical Services contractors. Each

entity provided updates to cost data that took into account changes in guidance applicable to the Risk MAP Program, changes in technology, and inflation. FEMA obtained consensus from all agencies before proceeding with the release of this document.

The unit costs provided in the following table are based on certain assumptions that reflect “typical” study conditions and may not accurately represent actual site-specific conditions. **Under no circumstance should these unit costs be used to estimate the cost of individual projects.** These figures are intended to provide an estimate of the value of the contributions to FEMA and not the actual cost incurred for the activity.

Any questions about these or other unit costs should be presented to FEMA for consideration. If the inclusion of additional unit costs is warranted, FEMA will update the document. Suggestions and the associated data should be presented to FEMA for future versions of this document.

## 6. Unit Costs

Table 1. Unit Cost Factors

Project Element		Unit	Unit Cost (\$/unit)
Discovery	Discovery	Community <sup>1</sup>	4,000
Risk Communication and Outreach	Outreach	Community	2,500
Field Surveys	Field Surveys and Recon	Linear miles	3,100
	Quality Assurance/Quality Control (QA/QC) for Field Surveys	Linear miles	500
Topographic Data Development	Very Flat Terrain		
	- Less than 1,000 sq. mi.	Square miles	500
	- Greater than 1,000 sq. mi.	Square miles	300
	Independent QA/QC Very Flat Terrain		
	- Less than 1,000 sq. mi.	Square miles	80
	- Greater than 1,000 sq. mi.	Square miles	50
	Rolling to Hilly Terrain		
	- Less than 1,000 sq. mi.	Square miles	250
	- Greater than 1,000 sq. mi.	Square miles	200
	Independent QA/QC for Rolling or Hilly Terrain		
	- Less than 1,000 sq. mi.	Square miles	40
	- Greater than 1,000 sq. mi.	Square miles	30
- Greater than 4-foot contours	Square miles	60	
Base Map Preparation	Base Map Preparation	Project	15,000
	Independent QA/QC of Base Map	Project	2,250
	Base Map Data 1-meter Orthophoto	Square miles	20
	Base Map Data 1-foot Orthophotos	Square miles	100

<sup>1</sup> Based on average of ten communities, may vary from project to project.

Project Element		Unit	Unit Cost (\$/unit)
Enhanced Study (Detailed Riverine <sup>2</sup> )	Hydrologic Analysis (Statistical)	Linear miles	1,000
	Independent QA/QC of Hydrologic Analysis (Statistical)	Linear miles	150
	Hydrologic Analysis (Rainfall Runoff)	Linear miles	3,000
	Independent QA/QC of Hydrologic Analysis (Rainfall Runoff)	Linear miles	300
	Hydraulic Analysis (1D Steady State Analysis)	Linear miles	4,000
	Independent QA/QC of Hydraulic Analysis (1D Steady State Analysis)	Linear miles	650
	Hydraulic Analysis (Unsteady State Analysis)	Linear miles	7,500
	Independent QA/QC of Hydraulic Analysis (Unsteady State Analysis)	Linear miles	600
	Hydraulic Analysis (2D Analysis)	Linear miles	7,500
	Independent QA/QC of Hydraulic Analysis (2D Analysis)	Linear miles	725
	Floodplain Mapping	Linear miles	1,500
	Independent QA/QC of Floodplain Mapping	Linear miles	200
	Redelineation	Linear miles	1,100
	QA/QC of Redelineation	Linear miles	165
	Enhanced Study (Limited Detail Riverine <sup>3</sup> )	Hydrologic Analysis	Linear miles
Independent QA/QC of Hydrologic Analysis		Linear miles	150
Hydraulic Analysis		Linear miles	1,600
Independent QA/QC of Hydraulic Analysis		Linear miles	300
Floodplain Mapping		Linear miles	1,300
Independent QA/QC of Floodplain Mapping		Linear miles	200
Perform Coastal Analysis	Grid Development	Node	0.70
	Independent QA/QC of Grid Development	Node	0.10
	Surge/Setup Analysis	Square miles	No data use actual costs
	Independent QA/QC of Surge/Setup Analysis	Square miles	No data use actual costs
	East Coast/Gulf Coast Wave Height/Runup/Erosion Analysis	Coastal Miles	3,100
	Independent QA/QC of East Coast/Gulf Coast Wave Height/Runup/Erosion Analysis	Coastal Miles	470
	West Coast Wave Height/Runup/Erosion Analysis	Coastal Miles	10,300
	Independent QA/QC of West Coast Wave Height/Runup/Erosion Analysis	Coastal Miles	1,550

<sup>2</sup> Previous designation for study type.

<sup>3</sup> Previous designation for study type.

Project Element		Unit	Unit Cost (\$/unit)
	Coastal Mapping	Coastal Miles	3,100
	Independent QA/QC of Coastal Mapping	Coastal Miles	470
Detailed Alluvial	Alluvial Fan Determination	Square Miles	500
	Hydraulic Analysis	Square Miles	3,500
	Independent QA/QC of Engineering Analyses	Square Miles	600
	Floodplain Delineation	Square Miles	1,300
	Independent QA/QC of Floodplain Delineation	Square Miles	165
Base Study (Approximate Analysis <sup>4</sup> )	Hydrologic Analysis	Linear Miles	150
	Independent QA/QC of Hydrologic Analysis	Linear Miles	25
	Hydraulic Analysis	Linear Miles	200
	Independent QA/QC of Hydraulic Analysis	Linear Miles	25
	Floodplain Mapping	Linear Miles	150
	Independent QA/QC of Floodplain Mapping	Linear Miles	20
DFIRM Production, Distribution, and Finalization	Develop Draft DFIRM Database	Project	4,500
	Preliminary DFIRM Production	Panels	1,300
	QA/QC Preliminary DFIRM Production	Panels	190
	Post-Preliminary DFIRM Production	Panels	1,700
Non-Regulatory Flood Risk Products	Changes Since Last Firm	Linear Miles	90
	Flood Depth and Analysis Rasters	Linear Miles	150
	Flood Risk Assessment	Linear Miles	1,000
	Areas of Mitigation Interest	Community	1,800
	Flood Risk Report, Database, and Map <sup>5</sup>	Project	15,000

## 7. Definitions

**Discovery:** Evaluate the project area to determine if a Risk MAP project is appropriate. The following activities may be included in this task: watershed stakeholder engagement, data analysis, discovery meeting and follow-up, first pass analysis, and scope refinement as defined in the Mapping Activity Statement and outlined in Appendix I of FEMA’s *Guidelines and Specifications for Flood Hazard Mapping Partners* and in the document *Risk MAP Meetings Guidance*.

**Risk Communication and Outreach:** Includes informational mailings, community meetings, Web site development and update, multi-media promotions, and other related activities. This element may also include meetings to discuss non-regulatory products.

**Field Surveys:** Includes the collection of supplemental information of an area of study, which may include conditions along floodplain(s), types and numbers of hydraulic and/or flood-control structures, apparent maintenance or lack thereof of existing hydraulic structures, data along cross sections, and other parameters needed for the hydrologic and hydraulic analyses.

<sup>4</sup> Previous designations for study type.

<sup>5</sup> Assumes prior tasks are complete.

**Topographic Data Development of very flat terrain and rolling to hilly terrain:** Generate new topographic data for areas where the floodplains are being updated as part of the mapping project. Topographic data includes contour mapping and or digital elevation models developed from light detecting and ranging (LiDAR) or other means that meet the requirements of FEMA’s *Guidelines and Specifications for Flood Hazard Mapping Partners*, Volume 1, Section 1.4, and Appendix A, Sections A.1, A.2, A.3 and A.4. Address all concerns or questions regarding the topographic data development and processing raised during the independent QA/QC review. FEMA’s topographic requirements generally call for vertical accuracy roughly equivalent to 4-foot contours (37 cm National Standard for Spatial Data Accuracy [NSSDA]). In exceptionally flat areas, the FEMA project lead may determine that accuracy roughly equivalent to 2-foot contours is needed (18.5 cm NSSDA). Other accuracy requirements for the topographic data shall be selected based on the current FEMA requirements as documented in Appendix A of the *Guidelines and Specifications for Flood Hazard Mapping Partners* and Procedure Memorandum 61.

Value for this element will only be given to topographic data acquired in the past 5 years or acquired since the last time the map was updated. Also, only the area being updated by the project is eligible for credit.

**QA/QC of Topographic Data Development of very flat terrain and rolling to hilly terrain:** Review the mapping data generated during Topographic Data Development to ensure that these data are consistent with FEMA standards and standard engineering practice and are sufficient to prepare the DFIRM.

**Base Map Preparation:** FEMA does not typically spend money on the acquisition of base maps. However, because partners often have a level of effort to prepare the base map data, credit will be given for completing the following within the project areas: obtaining digital files of the base map, securing necessary permissions from the map source to allow FEMA’s use and distribution of hardcopy and digital map products using the digital base map free of charge, reviewing and supplementing the content of the acquired base map to comply with the requirements of FEMA’s *Guidelines and Specifications for Flood Hazard Mapping Partners*, converting of the base map data to the format required in FEMA’s *Guidelines and Specifications for Flood Hazard Mapping Partners*, and certifying that the digital data meets the minimum standards and specifications that FEMA requires for DFIRM production. Products should meet the requirements of FEMA’s *Guidelines and Specifications for Flood Hazard Mapping Partners*, specifically Appendices K, L, N, and O and should follow the *Geospatial Data Coordination Implementation Guide*.

**Base Map Data 1-meter Orthophoto and 1-foot Orthophoto:** Supply a State- or community-produced digital orthophoto. A digital orthophoto is an aerial photo that has the accuracy properties of a map. To receive credit for this element, the base map cannot have been used on the last map update and must be less than 5 years old. Also, only the area being updated by the project is eligible for credit.

**Enhanced Study (Detailed Riverine) Hydrology (Statistical or Rainfall Runoff):** Review and recommend appropriate methodology; delineate drainage area; prepare digital profiles of the 10-, 4-, 2-, 1-, and 0.2-percent-annual-chance events; perform detailed hydrologic analyses (research land use and precipitation data, compute channel routing, conduct detention routing, build hydrologic model, calibrate/validate models); prepare draft Flood Insurance Study (FIS) text; perform internal quality review; and incorporate comments from independent quality reviewer. Special considerations should be made when processing rainfall runoff hydrology as compared to statistical hydrology analysis. Products should meet the requirements of FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners*.

**Enhanced Study (Detailed Riverine) Hydraulics (1-Dimensional or 2-Dimensional):** Conduct field visit to verify roughness coefficient and verify structural details (inlet types, conditions, etc.); integrate field survey data into modeling; prepare digital profiles of the 10-, 4-, 2-, 1-, and 0.2-percent-annual-chance events; prepare a floodway model; calibrate/validate models; prepare draft FIS text; prepare floodway data tables; prepare FIS profile; perform internal quality review; and incorporate comments from independent quality reviewer. Special considerations should be made when processing 2D hydraulic analysis as compared to 1D steady-state hydraulic analysis. Products should meet the requirements of FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners*.

**Enhanced Study (Limited Detail Riverine):** Perform hydrologic and hydraulic analyses using digital elevation data obtained by LiDAR to determine the 1-percent-annual-chance-event model, floodplain, and profile. Use digital elevation data and orthophoto imagery to estimate cross sections and structure locations. Where bridge or culvert data are available, such as from a Department of Transportation, use these data. Otherwise, field measure structures. Limited detail will not include mapping of regulatory floodways.

**Perform Coastal Analysis:** Delineate the 1- and 0.2-percent-annual-chance floodplain boundaries, VE and AE Zones, Primary Frontal Dune, Limit of Moderate Wave Action, and base flood elevations, as well as any other applicable elements for the flooding sources for which detailed coastal analyses were performed. Incorporate all new or revised coastal modeling and use the topographic data acquired under the Topographic Data Development project element to delineate the floodplain boundaries, VE and AE Zones, Primary Frontal Dune, Limit of Moderate Wave Action, and base flood elevations and any other applicable elements on a digital work map.

**Detailed Alluvial:** See Appendix G in FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners*.

**Base Study (Approximate Analysis):** Delineate the 1-percent-annual-chance floodplain boundaries for the flooding sources. Use existing topographic data or the topographic data acquired under Topographic Data Development project element to delineate the floodplain boundaries on a DFIRM. May expand on the approaches for analyzing Zone A areas outlined in FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners* and in FEMA 265, *Managing*

*Floodplain Development in Approximate Zone A Areas* (April 1995), and/or develop new approaches. Such approaches must be coordinated with and approved by FEMA before analysis and mapping begin.

**DFIRM Production, Distribution, and Finalization:** Delineate the 1- and 0.2-percent-annual-chance floodplain boundaries and the regulatory floodway boundaries (if required), as well as any other applicable elements for the flooding sources for which detailed hydrologic, hydraulic, alluvial, and/or coastal analyses were performed. Incorporate all new or revised hydrologic, hydraulic, alluvial, and/or coastal modeling and use the topographic data acquired to delineate the floodplain and regulatory floodway boundaries on a digital work map. Prepare the database and metadata file in accordance with FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners* for upload to the Mapping Information Platform. Coordinate with appropriate mapping partners, as necessary, to resolve any problems that are identified during development of the DFIRM database.

**Non-Regulatory Flood Risk Products:** Develop and finalize the following tasks as outlined in the Risk MAP program, Mitigation Planning and Flood Risk Products. A CTP's Mapping Activity Statement may include the completion of these activities: Changes Since Last FIRM, Flood Depth and Analysis Rasters, Flood Risk Assessment, Areas of Mitigation Interest, and the Flood Risk Report, Database, and Map. CTPs should reference the following FEMA guidance for the development of these non-regulatory products, Procedure Memoranda 57, 59, 59, and 60, in addition to Appendix N and O of FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners*.