

D.4.10 Study Documentation

This section summarizes the reporting requirements for coastal Flood Insurance Studies (FISs) on the Pacific Coast, with emphasis on the intermediate data submissions that document the basis and results of coastal flooding analyses during the course of the FIS.

Reporting requirements for coastal FISs shall follow guidance provided in Appendix M for the preparation of a Technical Support Data Notebook (TSDN). The TSDN shall consist of the following four major sections, which are more specifically described in Appendix M:

- General Documentation;
- Engineering Analyses;
- Mapping Information; and
- Miscellaneous Reference Materials.

The material compiled for these sections of a coastal FIS TSDN will be similar to a riverine study, with the exception of the Engineering Analyses section. The Engineering Analyses section of a TSDN for a coastal study shall be formatted to reflect the intermediate data submissions required for a coastal study.

D.4.10.1 General Documentation

This portion of the TSDN incorporates background information compiled by the Mapping Partner related to changes in scope; special problem reports (SPRs); minutes of meetings held with the Federal Emergency Management Agency (FEMA), communities, and other Mapping Partners; and all correspondence for the study effort (email and hard copy). A complete list of TSDN reporting requirements for General Documentation is provided in Appendix M.

D.4.10.2 Engineering Analyses

Due to the complexity of coastal studies, intermediate data submissions are required from the Mapping Partner. Intermediate data submissions provide defined milestones in the coastal flood study process for review of study approach and results. The Mapping Partner shall submit the data to FEMA in accordance with the sequence discussed below.

The following intermediate data submissions are required from Mapping Partners, who perform coastal FISs unless otherwise specified by FEMA:

- Intermediate Submission No. 1 – Scoping and Data Review
- Intermediate Submission No. 2 – Offshore Water Levels and Waves
- Intermediate Submission No. 3 – Nearshore Hydraulics
- Intermediate Submission No. 4 – Draft Flood Hazard Mapping

The Mapping Partner shall receive review comments within 30 days of the receipt of each data submission. The Mapping Partner performing the study shall establish a work plan, so the

interim review does not cause any delay in the submission of the draft FIS report and Flood Insurance Route Map (FIRM) reflecting the results of the coastal study.

D.4.10.2.1 Intermediate Submission No. 1 – Scoping and Data Review

In this phase of reporting, the Mapping Partner provides the background information on the study setting and available data relevant to the study area. Any new data needed for the detailed coastal analyses in the following phases (i.e., Offshore Waves and Water Levels; Nearshore Hydraulics) shall be identified in this phase. Unless otherwise agreed upon with FEMA, the study shall not proceed until all of the information is available and incorporated in the scoping document for approval.

- **Topographic and Bathymetric Data:** If available at this stage, this submission shall include survey control data, topographic data from aerial photography, Light Detection and Ranging (LIDAR), field surveys, and bathymetric survey data. If survey work is still in progress, the submission shall include available data at the time of submission and a detailed description of the planned survey data collection. Information shall be submitted on the extent of topographic and bathymetric mapping, key mapping parameters (e.g., contour intervals and accuracy standards), horizontal and vertical datums, location and extent of transects, and other pertinent information describing the extent and quality of survey information to be used in the study. If existing community mapping data will be used to supplement survey efforts for the study, the Mapping Partner shall submit information on the date, accuracy standards, datums, extent, and any limitations of the mapping.
- **Tide, Wind, Wave, Current, and Flooding Data:** This submission shall include a description of available tidal elevation, wind speed, and wave data that relate to study analysis requirements. The submission shall include an evaluation of local and regional tide gage records recognizing that these include astronomical tide, surge, El Niño, and possibly other influences (e.g., river flows, wave setup); residuals based on astronomical tide predictions shall be included where relevant to the study analysis. The submission shall include review and selection of wind stations in the vicinity of the study area that can provide reasonable length of record, hourly values, and peak gusts to help estimate extreme wind statistics; evaluation of available wave or wave hindcast data; evaluation of available current data and evaluation of the influence of currents on coastal flooding, if any; and evaluation of available historical data (measured and anecdotal) on past coastal flood events.
- **Site Reconnaissance:** Results of the site reconnaissance shall be summarized to characterize exposure and coastal morphology by shoreline segment or reach; provide an inventory of existing coastal structures and levees; characterize coastal vegetation where it may influence coastal flooding analyses and mapping; identify transect locations to be field surveyed; describe the rationale for selection of transects to represent shoreline segments and reaches in subsequent water-level and wave calculations; and describe any unusual study area characteristics (e.g., floodborne debris, tsunamis, beach nourishment, multiple levees, etc.) that may require special consideration in the study or further guidance from FEMA.

- **Technical Approach:** The submission shall describe the technical approach to analysis of coastal processes and mapping flood hazards in the various settings and shoreline morphologies present in the study area.

D.4.10.2.2 Intermediate Submission No. 2 – Offshore Water Levels and Waves

Documentation of this phase shall describe the primary analyses of water-level and wave conditions to be applied during the detailed analyses in the nearshore hydraulics phase. Where applicable, the submission shall include:

- **Wave Data and Hindcasts:** The submission shall describe data and analyses used to select and define storm events for use in response-based analysis of nearshore processes and subsequent statistical analysis of 1% and 0.2% annual chance flood conditions. Documentation shall include details of the sources of wave and wind data. It shall also include comparisons between alternate sources (where more than one is available and feasible for use in the FIS) and comparison with local measurements. Documentation of incident deepwater waves should include period, direction, and directional spreading parameters. The selection of coefficients for angular spreading and spectral peakedness parameters shall be clearly stated and justified.
- **Estimation of the 1% and 0.2% Annual Chance Flood:** Documentation shall be provided on the methods to be used to estimate the 1% and 0.2% annual chance coastal flooding conditions. These may include response-based and joint probability methods, depending on study setting. Methods of extrapolation of hindcast and/or measured data to 1% and 0.2% annual chance values should be documented, including comparisons between alternate procedures if appropriate. Where extremal analyses of wave, wind, water level, and residual tides are used, the submission shall include documentation of the analyses to develop frequency relationships, including a description of the data sets and analysis assumptions.
- **Sheltered Waters – Hindcast Waves:** Documentation shall be provided on fetch length determination and corresponding wind speeds, directions, and durations for use in hindcast analyses. This shall include documentation of wind speed adjustments and wind field hindcast methods.
- **Sheltered Waters – Water Levels:** The Mapping Partner shall document the characteristics of tide gages located within or near the study area that will potentially be used in study analyses or validation. Methods adopted to infer the variation of tidal datums between gages shall be documented, as shall procedures used to transpose data from one site to another. If a field effort is undertaken to determine the variation of tidal datums within ungaged regions, the Mapping Partner shall fully document that effort, including: locations of observations; observation methods and instrumentation; dates and times of all observations; meteorological and oceanographic conditions during and preceding the period of observation; and other factors that may have influenced water levels, or that may affect interpretation of the results. If surge variation is inferred from tide variation, the Mapping Partner shall document the basis for similarity assumptions, and the manner in which the inferences were made. Inlet analyses shall be documented,

including all procedures, methodological assumptions, field surveys (dates, times, procedures, instrumentation, and findings), and all inlet data adopted from other sources.

D.4.10.2.3 Intermediate Submission No. 3 – Nearshore Hydraulics

The nearshore hydraulics phase provides documentation of methods applied and detailed analyses conducted before the hazard zone mapping phase.

Wave Information: The Mapping Partner shall document all assumptions used to define waves. In sheltered waters, this shall include a summary of fetch determination, winds (speeds, directions, duration), and bathymetry used in hindcasts. The documentation shall include the approximations or assumptions used in the analysis. When observational data, such as wave buoy data, are available, the wave height, period, and spectral parameters should be compared to the predicted waves.

- **Wave Transformation:** The Mapping Partner shall document the assumptions, methods, and results of all analyses of wave transformations conducted for the FIS. This documentation shall include selection of offshore and nearshore points, source of transformation coefficients, and any special assumptions regarding local transformation processes such as sheltering and reflection. If a spectral wave model is applied for nearshore transformation, all modeling factors shall be sufficiently documented, so the modeling effort can be reproduced if necessary. If a field effort is undertaken to validate transformation models, the field work shall be summarized in detail, including times and locations of all observations, general conditions at the time of the work, a full description of all equipment and procedures, and a summary of all data in archival form. A description of the bathymetric data used in the transformation calculations shall be provided.
- **Runup, Setup, and Overtopping Analyses:** The Mapping Partner shall document the runup, setup, and overtopping analysis assumptions, methods, input data, and results. This shall include a description of overtopping cases for the annual maxima data, determination of total water level (TWL), and determination of flood hazard zone parameters (1% and 0.2% flood depths, overtopping splash penetration and overtopping rate, and overland flow velocity) at each transect. This shall include a description of profiles used, runup reduction factors, and basis for splash zones to be used in hazard mapping. The documentation shall include a description of any observations or measurements used to validate or adjust analysis results, any deviations from recommended procedures in Section D.4.5, any difficulties encountered in the analyses, and the technical decisions or approaches taken in their resolution.
- **Wave Dissipation and Overland Propagation:** The Mapping Partner shall describe the areas where wave attenuation was investigated, and document the analysis assumptions, methods, input data, and results. This shall include documentation of any field observations or measurements, as well as available historical or anecdotal information regarding wave attenuation during flooding events.
- **Coastal Armoring Structures:** The Mapping Partner shall describe assumptions and investigations of the various coastal armoring structures (e.g., seawalls, revetments,

bulkheads, levees, etc.) in the study area relevant to stability and capability to withstand 1% annual chance water-level and wave conditions. This documentation shall include any assumptions or approximations used in the analyses. The same documentation shall be required in the event that coastal structures are apparently buried and not visible, but are indicated by information collected during the FIS. In cases where the Mapping Partner could not determine whether a given structure would survive the 1% annual chance flood intact, and where multiple analyses were conducted for the structure (i.e., intact condition, failed condition/removed from the analysis transect), the Mapping Partner shall document each analysis and record the structure condition that was used to map flood hazard zones and Base Flood Elevations (BFEs). This information will be useful in the event a map revision is requested based upon a structure condition different from that used as the basis for the FIRM. The Mapping Partner shall consult with the FEMA study representative regarding the treatment of levees (single levees or multiple levee systems) during the FIS.

- **Beach Stabilization Structures:** The Mapping Partner shall document the treatment of beach stabilization structures (e.g., groins, offshore breakwaters, sills, etc.) during the FIS. If the Mapping Partner proposes removal or modification of beach stabilization structures (or their shoreline effects) during the 1% annual chance flood, the Mapping Partner shall document the existence, history of, and shoreline response to beach stabilization structures, and consult with the FEMA study representative.

Miscellaneous Structures: If miscellaneous structures (e.g., piers, port and navigation structures, bridges, culverts, tide gates, etc.) are present in the study area and could exert a significant influence on nearshore waves, currents, sediment transport, or backshore ponding, the Mapping Partner shall document the data, methods, and procedures used to evaluate the stability of these structures during the 1% annual chance flood and their effects on coastal flooding. This documentation shall include any assumptions or approximations used in the analyses.

Erosion Analyses: The Mapping Partner shall document the erosion analysis assumptions, methods, input data, and results. A description shall be provided of the data used to determine Most Likely Winter Profile (MLWP) and Eroded Profile conditions, and the methods used to estimate profile adjustments as a function of annual maxima data and 1% TWL conditions. Where applicable, the potential recession and recession reduction factor shall be reported at each transect.

- **Verification to an Observed Coastal Flood Event:** Where available, background information shall be provided for measured and anecdotal historical coastal flood data at or near the study area that are used in verification of the FIS analyses. This shall include a description of the method used (if any) to reconstruct wind and water-level data during the flood event, observed flood conditions, elevations, and areas of inundation. Where possible, the recurrence interval of the observed event should be estimated.
- **Special Study Considerations:** The Mapping Partner shall document any unusual conditions in the study area and the methods proposed to map hazard zones based on these conditions. These may include tsunami-related hazards, effects of beach nourishment, effects of floodborne debris, special hydrodynamic considerations in tidal

inlets and passages, effects of riverine inflows, unusual erosion or other sedimentation characteristics, unusual structure effects, effects of multiple levees, and any other factors that the Mapping Partner considers relevant to mapping flood hazards accurately.

D.4.10.2.4 Intermediate Submission No. 4 – Draft Flood Hazard Mapping

The draft flood hazard mapping phase provides documentation of the methods used to convert the results of the detailed hydraulic analyses to flood hazard zones.

- **Flood Hazard Zone Limit Identification:** The Mapping Partner shall document the analysis results used in the determination of hazard zone limits and BFEs. This shall include a summary table by transect of results for 1% TWL, 1% SWL, and determination of flood hazard zone parameters (1% and 0.2% flood depths, overtopping splash penetration and overtopping rate, overland flow velocity, overland wave propagation, and primary frontal dune location), as appropriate. In addition, the summary shall include a description of the basis for erosion and coastal structure conditions (e.g., overtopping cases, method of profile determination, failed and buried coastal structure cases, etc.) used in the determination of the hazard zones.
- **Flood Hazard Zone Map Boundary Delineation:** The Mapping Partner shall provide draft work maps for the study area showing all flood hazard zone limits identified along the transects resulting from the detailed analyses and transferred to the topographic work maps. This submission shall describe the engineering judgment used to interpolate and delineate hazard zones in between transects, including land features that might affect flood hazards, changes in contours, and the lateral extent of coastal structures. It shall also provide detailed documentation and technical justification of adjustments in the hazard zone mapping that were made due to observed historical flood data and/or damages in the study area.

The Mapping Partner shall incorporate all intermediate submissions and modifications based on review comments in each phase into the Engineering Analyses section of the TSDN.

D.4.10	Study Documentation.....	1
D.4.10.1	General Documentation	1
D.4.10.2	Engineering Analyses	1