Panel Decision & Report

SRP MAES042211 Ring's Island, Salisbury, Essex County, Massachusetts

November 10, 2011

National Institute of
BUILDING SCIENCES

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Summary

Based on the submitted scientific and technical data and within the limitations of the SRP, the Panel has determined that the Community's data does not satisfy NFIP standards, thus FEMA's data is not corrected, contradicted, or negated

About the Scientific Resolution Panel (SRP) and Authority

Under contract with FEMA, the National Institute of Building Sciences (the Institute) establishes SRPs for the purpose of performing independent reviews of scientific and technical data used by FEMA to develop flood elevations for the National Flood Insurance Program's Flood Insurance Rate Maps. SRPs review FEMA's flood hazard data and the flood hazard data submitted by the Community to determine which studies are technically and scientifically more accurate and render a written decision that denies or accepts the alternative flood elevations submitted by a Community. The decision of the Panel serves as a recommendation to the FEMA Administrator for resolution of the conflicting data.

SRPs are established to achieve the following benefits to both FEMA and communities. SRPs

- Offer a process deemed neutral for all parties.
- Offer the best independent scientific and technical expertise available to review and decide on conflicting flood hazard data and flood maps.
- Provide faster resolution to Community challenges of proposed flood elevations.

Panel Members

The following individuals were selected by the Community and FEMA to serve on the SRP MAES042211 Ring's Island, Salisbury, Essex County, Massachusetts:

- **Dr. Thomas Ballestero**, Ph.D., P.E., P.H., P.G., Associate Professor of Civil Engineering, University of New Hampshire, Durham, New Hampshire.
  Tom Ballestero has taught hydraulic models that support flood insurance studies, since 1976. This includes riverine, lacustrine and coastal settings. His research and consulting efforts focus on stormwater management, environmental hydraulics, and stream restoration.
- **Avalisha Fisher, P.E.**, President and Principal Engineer, Driven Engineering, Semmes, Alabama.
  Ms. Fisher is a professional engineer with over 20 years of experience in water resources engineering and founded Driven Engineering, Inc. She has performed and directed numerous hydrologic and hydraulic studies to establish and correct mapped coastal, estuarine, and riverine floodplains as part of the NFIP mapping program. Ms. Fisher recently completed a flood map modernization project including over 30 miles of stream studies for Mobile County, Alabama which was funded by a grant from the National Oceanic and Atmospheric Administration. Ms. Fisher holds Professional Engineering licensure in eleven US States.
- **Douglas Hamilton, P.E., D.WRE,** Civil Engineer, Hydraulics, Irvine, California.

Mr. Hamilton has 25 years of experience in coastal, riverine, and alluvial fan hydraulics related to the identification and mitigation of flood hazards. While with the Hydrologic Engineering Center, Mr. Hamilton worked on several important flood hazard policies and methods related to the National Flood Insurance Program (NFIP) administered by FEMA. During his career, he has prepared Flood Insurance Studies, Floodplain Map Revisions, participated in and resolved Floodplain Map Appeals, and has served as a National Research Council Committee Member for NFIP Policy matters. Mr. Hamilton holds Professional Civil Engineering Licenses in California, Missouri, and Nevada.

- **Roger Kilgore, P.E., D.WRE**, Principal, Kilgore Consulting and Management, Denver, Colorado. Mr. Kilgore is a professional engineer with 30 years of experience in water resources engineering and research and is Principal of Kilgore Consulting and Management. He has performed and directed numerous hydrologic and hydraulic studies to establish floodplains and has assessed coastal and riverine flood damage for the NFIP. Mr. Kilgore currently teaches coastal engineering principles on behalf of the Federal Highway Administration. His research efforts include development of statistical tools to assess the joint probability of flooding for the National Academies of Engineering.
- **John Lally, P.E.**, Principal Coastal Engineer, Lally Consulting, Seattle, Washington
  Mr. Lally is a professional engineer with over 20 years of project experience in coastal engineering and marine construction. He has performed and overseen coastal process analyses, hydrographic surveys, dive surveys, oceanographic data collection, numerical modeling of waves and currents, coastal engineering design, and construction management, for a broad range of environmental restoration, shoreline protection, and navigation projects in coastal, riverine and lacustrine environments. Mr. Lally holds a professional Civil Engineer's License in the State of Washington.

Charge to Panelists

The Panel shall convene to review the conflicting data submitted by FEMA and the Community, hear oral presentations from FEMA and the Community if deemed necessary and establish a majority decision on the appropriate data.

Panel members will receive from FEMA the data used to generate the challenged flood elevations and the contesting data submitted by the Community during the 90-day appeal period. The Panel will first review the FEMA data that was contested for sound engineering practices and principles and compliance with NFIP standards. Then the Panel will review the Community data on a point-by-point basis to determine which elements satisfy NFIP mapping standards and negate the FEMA data.

The Panel shall:

- First, review the contested FEMA data for sound engineering practice and principles and compliance with The NFIP mapping standards

- Second, review the Community data and determine if
    - it satisfies NFIP mapping standards, and
    - it is superior to FEMA data.
- Establish its decision based on these reviews and recommend either the acceptance or denial of the Community submitted data for inclusion in a revised flood map in part or in whole.

The decision to accept or deny the appeal or protest shall include one of the following explanations:

- FEMA's data does not satisfy NFIP mapping standards defined in FEMA's Guidelines and Specifications for Flood Hazard Mapping Partners (NFIP standards) and must be revisited.
- The Community's data satisfies NFIP standards and wholly corrects or negates FEMA's data.
- Portions of the Community's data satisfy NFIP standards and correct or negate FEMA's data.
- The Community's data does not satisfy NFIP standards, thus FEMA's data is not corrected, contradicted, or negated.
- The Community's data satisfies NFIP standards and is correct, but does not negate FEMA's data.

A simple majority vote of the Panel shall decide to either recommend FEMA accept or deny the Community's alternate flood elevations in part or in whole.

The Panel will present its written report to the Community and FEMA within 150 days of being convened, and it will serve as the recommendation to the FEMA Administrator when making the final determination. The report should include the identification of Panel members, a description of the appeal or protest, a list of data submitted by the Community and FEMA, a summary of Panel procedures, the recommendation to either deny or accept the Community's data in whole or in part, any other recommendations to FEMA, and its rationale for its findings.

Panel Review and Decision Procedures

Prior to the first Panel meeting, the Institute created a single data portal which contained the technical and programmatic information provided both by the Community and by FEMA (Including the Technical Support Data Notebook from FEMA's Flood Hazard Mapping Partner). The Portal also contained the SRP rules and guidelines under which the Panel would conduct their review and decision-making. During the first teleconference / web-based presentation a Chair of the panel was appointed. The Chair's responsibility for coordinating and communicating with the Institute, the Panel, as well as this person's role in completing the report was discussed. During the first meeting the schedule and milestones for completing the SRP review and decision was also established.

After the first Panel meeting, the NFIP regulations, and guideline documents were added to the Portal. The Panel then reviewed the technical information and other data provided by both the Community, and by FEMA. Both individual communications between Panel Members and joint deliberation with the Institute Director were held. A teleconference / web-based presentation was held with the Panel, the Institute, the Community and FEMA. Both the Community and FEMA were allowed to give presentations. The Panel was then allowed to ask questions to both parties to clarify issues and evaluate

the disagreements. All parties were allowed to listen to this call and to comment. Both the Community and FEMA were offered the opportunity to provide additional technical information to the Institute based on overall content of the call.

A draft report outlining the SRP program, procedures, technical data reviewed, and oral presentation from Community and FEMA was prepared. This report was modified to a final report containing conclusions regarding the overall technical superiority of the information submitted to the Institute by both the Community and by FEMA. A vote was held within the parameters of the Institute's rules, and the Panel's final decision was based on a simple majority of the five panel members.

Flood Insurance Rate Map (FIRM) Proposed by FEMA

On May 28, 2009, FEMA issued preliminary Flood Insurance Rate Maps (FIRMs) for all Jurisdictions of Essex County, Massachusetts, including the Ring's Island Area of the Town of Salisbury (the subject of this SRP). The Ring's Island area is fully contained on FIRM Panel 128 of 600. This indicates that FEMA's restudy of Essex County covers a much larger geographic area than the specific location that was appealed by the Town of Salisbury. FEMA re-issued Panel 128, printed with an Effective Date of July 18, 2011. However the re-issued panel is still DRAFT and is currently not effective. For Panel 128 the mapped 1% flood hazard elevations on the 2009 FIRM are slightly higher compared to the 2011 FIRM.

Technical Basis for Wave Height Analysis for FEMA Re-Mapping of Essex County Massachusetts Including Ring's Island, Salisbury, Massachusetts

FEMA's technical basis for the re-mapping of Essex County, Massachusetts is based on a document prepared by FEMA Region VI and FEMA Headquarters, updated in 2007, entitled *Atlantic Ocean and Gulf of Mexico Coastal Guidelines Updates*. Phase 3 of this updated report contains additional guidelines for preparing flood maps in response to scientific information and experience assembled from Hurricanes Katrina and Rita. Section D.2 of this report deals with the Atlantic Coast from the Maine-Canada border to the Southern-most parts of Florida. In February 2007, the above-referenced document superseded previous guidance contained in FEMA's 2003 *Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix D* (Guidelines) (http://www.fema.gov/plan/prevent/fhm/dl_vzn.shtm#3). The fact that the 2003 coastal wave height flooding guidance was replaced with the 2007 coastal wave flooding guidance was verified by FEMA during the joint teleconference that included the Community's oral presentation, FEMA's oral presentation, the Institute's statement, and the Panel's discussion which took place on August 16, 2011. All parties heard the entire contents of the teleconference which lasted approximately 4 hours.

FEMA's mapping procedures for shallow-water overland flooding due to wave propagation across areas that could be affected by wind-caused, coastal waves are in Sections D.2.7.1 and D.2.7.2 of the Guidelines. At the time of the Community's Appeal of FEMA's proposed FIRM explained in a letter from Vine Associates, dated December 9, 2009, the above-referenced 2007 Guidance had already been in force.

Essentially, the 2007 Guidelines require the use of a computer program known as WHAFIS. This program uses representative transects to compute wave crest elevations in a given study area, resulting from a combination of riverine flood discharge toward the sea and the increase in the elevation of the sea caused by large-scale, regional wind fields. For coastal areas, FEMA refers to this as the "Stillwater Elevation" (SWL or SWEL) during a storm surge flood event.

The "wave crest" is a discrete water level increase above the SWEL equal to 78% of the water depth at the location of the SWEL. In other words, the magnitude of the "wave crest" increase is 78% of the difference between the SWEL and the local ground elevation of the land. Finally, FEMA requests that 70% of the "wave crest" increase is added to the SWEL. Thus the mapped 1% flood elevation, including wind waves, is 1.55 times the depth of water at the SWEL (FEMA uses 1.6 times). The final computed water elevation is referred to as the "controlling wave height" and this is the elevation to be placed on the FIRM.

WHAFIS accounts for both the amplification of wave crest height due to wind, and the possible dissipation of the wave crest elevation due to plants and other barriers. The critical aspect of using the WHAFIS computer program, as pointed out by FEMA in their SRP Oral Presentation during the conference call of August 16, 2011, is that, for relatively shallow coastal flood waves travelling overland, the controlling wave height elevation is 1.6 times greater than the local depth of the SWEL (Guidelines, Section D.2.7, p. D.2.7-3, including Footnote 5).

During the August 16, 2011 SRP Oral Presentations conference call, FEMA had misstated this issue. However FEMA clarified this in an email to the Institute dated September 28, 2011.

Using the computed SWEL in the Merrimack River, and the controlling wave heights developed by the methods discussed in the guidance, FEMA then produced the FIRM dated July 18, 2011. At the time the report was written, FEMA had not yet designated the July 18, 2011 FIRM to be the effective FIRM.

The Panel's review of documents and discussions with the parties revealed no disagreement regarding the computed SWELs along the Merrimack River.

Conclusion on Controlling Wave Height

The Community did not follow FEMA Guidelines for determining the controlling wave height. The Community's technical position is that the 1% chance SWEL in the Merrimack River at Salisbury and the 1% chance wind could not be concurrent. The Community did not prepare technical or scientific information persuasive enough to convince FEMA to waive their controlling wave height guidance.

On pages 7 and 8 of 20 of the Technical Supporting Data Notebook (TSDN) prepared by FEMA's Mapping Partner, Ocean and Coastal Consultants (OCC), a northeaster in February 2007 was documented. OCC concluded that coastal flood damage and dune erosion occurred within the study area because of wave action and tidal surge during the flood event.

Because the controlling wave height guidance was not used, the proposed FIRM prepared by the Community is not as technically accurate as the proposed FIRM prepared by FEMA. The FIRM prepared by OCC and put forth by FEMA is more technically accurate because it is based on current FEMA guidance on the calculation of the controlling wave height.

Technical Basis for Wind Magnitude, Direction and Fetch Length for FEMA Re-Mapping of Essex County Massachusetts

An excerpt from the data provided by FEMA contains a section entitled *WIND SPEED DETERMINATION* dated June 13, 2007, prepared by OCC, a contractor to FEMA. This approach develops 1% chance wind speed data from Figure 6-1 (which is for the general geographic location of the subject FIS) from *Minimum Design Loads for Buildings and Other Structures,* published by the American Society of Civil Engineers (ASCE).

Use of the ASCE wind data set by FEMA is scientifically reasonable and programmatically consistent given the large geographic extent of the Essex County flooding analyses. For more detailed site specific analysis such as flooding of Ring's Island, collecting historical or empirical wind data from sources that are more proximate is reasonable. In the general practice of conducting an FIS over a large coastal area, collection of exhaustive wind speed data from individual airports, National Data Buoy Centers, State DOTs, airports or other meteorological stations is not normally done. There are courses of action within the NFIP for a Community to revise or attempt to revise a portion of a FIRM, if the means and data are available to do so.

Flood Insurance Rate Map (FIRM) Proposed by the Community

After FEMA issued its May 28, 2009 Preliminary FIRM based on the new FIS for Essex County, Massachusetts, the Community of Salisbury, Massachusetts filed an Appeal under the provisions of Title 44, Chapter I, Part 67, Code of Federal Regulations in a letter from Vine Associates, Inc. (VAI) dated December 9, 2009.

The specific issues presented by the Community to FEMA in their appeal of the 2009 preliminary map are:

- The V-Zone flood hazard delineation is inappropriate
- FEMA's analysis is consistent with [their own principles] of coastal flooding analysis
- FEMA utilized wind data which overestimates the 1% probability of storm wind velocities
- FEMA's transects are not consistent are not representative of the Ring's Island Shoreline
- FEMA overestimates the fetch distances for the Ring's Island shoreline.

The Community concludes that the location of Transect SB-9 used in the FIS study is not representative of the Ring's Island area and retained VAI to provide additional detailed wind analyses that could more accurately identify the 1% chance wind characteristics for Ring's Island. The wind analyses prepared by VAI used different sources of measured wind data that is more proximate to Ring's Island. Multiple wind

transects and fetch lengths were also considered. This resulted in lower wind speeds than those used by FEMA's adopted analysis.

The Panel's assessment is that the location of Transect SB-9 does accurately enough represent the Ring's Island area for south or southeast winds, and is representative of fetch distances near the Community. The new transects SB-9A, and SB-9B, developed by VAI on behalf of the Community do not account for south and southeast winds which are known to occur during flood events.

In a second letter from VAI dated January 13, 2011, the Community submitted additional data to FEMA. In *Attachment A, Narrative Summary*, page 1, the statement is made: "The primary contention of the Town's appeal is that the 1% winds do not occur during storm events that generated the 1% flood levels on the northern shoreline of the Merrimack in the Ring's Island area". VAI does not provide a scientific and technical basis that demonstrates there could not be a series of atmospheric events resulting in a coincidence of large floods in the Merrimack River and strong winds causing wave run-up, and overland flood propagation onto Ring's Island, nor do they address the conclusions of the TSDN pages 7 and 8 regarding the northeaster of February 2007. VAI references a February 10, 2010 letter from FEMA from which they infer or conclude that FEMA agrees with the Community's hypothesis of non-concurrence of the 1% chance flood in the Merrimack River and the 1% chance wind. However, FEMA's February 10, 2010 letter does not contain an affirmative statement to this effect. Instead, FEMA requests that the Community consider wave run up and overland flow propagation characteristic of coincident riverine flooding and wind-generated waves.

Conclusion of the Technical Basis of Community's Wave Analysis

The Community raises a reasonable concern about sparseness of wind transects used to develop wind speed for FEMA's overall study area of the FIS. The VAI analysis provided to the Panel by the Community is more detailed near Ring's Island. However, the Community does not provide sufficient technical or scientific information demonstrating that a 1% flood event could not coincide with a 1% wind event to an extent such that it would be unreasonable for FEMA to include the effect of wind-caused coastal waves resulting in shallow overland flooding at Ring's Island.

Conclusion of the Panel

The Panel confirmed that both FEMA and the Community agree that a northeaster is the most technically correct generator for the 1% chance flood hazard event. Neither Party requested the Panel to examine this specific issue. Both FEMA and the Community also agree that the SWEL developed by FEMA on the Merrimack River near Community of Salisbury is appropriate. There are two primary technical issues with which the two Parties disagree:

- The calculation of shallow-water wind wave heights for the 1% chance event, and
- The wind characteristics for the 1% chance event including speed, direction, fetch, and transects.

With respect to the calculation of wave height above the SWEL, the Community argues that there should be no shallow-water wind waves concurrent with flooding in the river and, therefore it is not necessary to apply the conversion factor of 1.6 to increase the "significant wave height" to the "controlling wave height." The Panel is aware that FEMA did not grant a waiver or compromise to the Community regarding the necessity of using this factor.

The Community raises a reasonable issue regarding the concurrence of a 1% chance flood event on the Merrimack River with the 1% chance wind event. However, the Community did not provide technical or scientific information persuasive enough to convince FEMA to waive their controlling wave height guidance. Furthermore the February 10, 2010 letter from FEMA does not affirmatively support the Community's hypothesis of non-concurrence of the 1% chance flood in the Merrimack River and the 1% chance wind.

The Panel conducted a review of documents from FEMA and the Community; participated in presentations by, and discussions with FEMA and the Community; made queries regarding additional information; conducted internal Panel discussions both with the entire panel and the Director, and, also, among individual Panel members. Each of the five Panel members were asked to vote for one of five possible conclusions based on their review of the scientific and technical information submitted for their review. The vote was unanimous (Five to Zero) that the "Community's data does not satisfy NFIP standards, thus FEMA's data is not corrected, contradicted, or negated."

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Appendix

Documents Reviewed by Panel, Provided by Parties, and Related Regulations, Guidelines and Procedures.

FEMA Data

Federal Emergency Management Agency, *Town of Salisbury, Essex County, Massachusetts, Technical Supporting Data Notebook*, April 27, 2011 http://panels.floodsrp.org/files/?artifact_id=2566:

- Ocean and Coastal Consultants, Inc., *DFIRM & FIS Update, Summary Report, Coastal Engineering Analyses for Flood Insurance Study Revision in Essex County, Massachusetts, Hydrologic Analysis*, September 14, 2007.
- Ocean and Coastal Consultants, Inc., *Wind Speed Analysis for Essex County, Massachusetts*, June 13, 2007.
- Ocean and Coastal Consultants, Inc., *Transect SB-9 -Transect Profile, ACES Restricted Fetch Wave Height Analysis Wave Setup Analysis, WHAFIS Analysis Summary, Run-up Analysis - ACES Beach*, August 2 & 31, 2007.

Federal Emergency Management Agency, *Appeal Resolution Letter from Michael J. Goetz, Region I Branch Chief to Mr. Donald W, Beaulieu, Chairman, Board of Selectman, Town of Salisbury Massachusetts*, December 15, 2010 http://panels.floodsrp.org/files/?artifact_id=2567.

Community Data

Vine Associates, *Scientific Resolution Panel Request letter with Attachments from Peter J. Williams on behalf of the Town of Salisbury,* January 13, 2011, http://panels.floodsrp.org/files/?artifact_id=2561 including*:*

- Federal Emergency Management Agency, *Scientific Resolution Panel Request Form from Neil J. Harrington, Salisbury Town Manager*, January 12, 2011.
- Attachment A – *Scientific Resolution Panel Request*, *Summary of Appeal or Protest.*
- Exhibit 1 – *Town of Salisbury Appeal*, December 9, 2009.
    - Attachment A – *Appeal of Proposed FIRM Revisions, Restricted Fetch Analysis, Ocean and Coastal Consultants, Inc., FEMA FIS Hydraulic Analyses, ACES Procedure Memorandum,* June 12, 2007.
    - Attachment B - *Appeal or Proposed FIRM Revisions, Revere Beach GDM Wind Data, USACE General Design Memorandum, Beach Erosion Control Project* , June 1986 http://panels.floodsrp.org/files/?artifact_id=2562.
    - Attachment C – *Appeal of Proposed FIRM Revisions, Boston Harbor Wind Rose, Wave, Hydrodynamic, and Sediment Transport Study of Northern Long Island, Boston Harbor, Interim Report, Boston and Northeastern Universities,* November 2007.
    - Attachment D – *Appeal of Proposed FIRM Revisions, Transect SB-9 Wave Analysis Summary, Ocean and Coastal Consultants, Inc.*, August 2 & 31, 2007.
    - Attachment E – *Appeal of Proposed FIRM Revisions, Vine Associates, Inc. Height Calculations and Fetch Radials figures 4 & 5.*

- Exhibit 2 – *Federal Emergency Management Agency Additional Information request letter*, February 10, 2010.
- Exhibit 3 – *Vine Associates Additional Information Letter,* March 22, 2010 http://panels.floodsrp.org/files/?artifact_id=2563.
- Exhibit 4 – *Proposed Mapping Revision, Figure No. 1*, January 11, 2011 http://panels.floodsrp.org/files/?artifact_id=2564.

National Institute of Building Sciences, *Scientific Resolution Panel Community Submittal Agreement signed by Neil Harington*, March 15, 2011 http://panels.floodsrp.org/files/?artifact_id=2565.

Documents Requested By Panel

August 10, 2011 Request for Additional Information – Transect Location Map Created during Revision Studies http://panels.floodsrp.org/files/?artifact_id=2622:

- Ocean and Coastal Consultants, Inc., *Flood Insurance Study Revision, Essex County, MA, Coastal Analysis, Town of Newbury and Salisbury, City of Newport Transect Location Map, Figure No. 9*, June 2, 2008.
- Federal Emergency Management Agency, *NFIP FIRM Essex County, Massachusetts, All Jurisdictions Preliminary, May 28, 2008.*
- Federal Emergency Management Agency, *NFIP FIRM Essex County, Massachusetts, All Jurisdictions Effective Date, May 28, 2008.*

August 16, 2011 Request for Opinion from FEMA's Contractor– Opinion on the proposed mapping provided by the Town of Salisbury which is reflected on the figure titled Town of Salisbury, Massachusetts Map Revision, prepared by GZA, dated January 11, 2011; and the source of the wind speed data considered by FEMA and its mapping partner when making the decision to utilize the American Society of Civil Engineers (ASCE) *Standard Minimum Design Loads for Buildings and Other Structures*, Edition 7-05, Figure 6-1 as the source of wind speed inputs for the Essex County Flood Insurance Study.

- Responses provided by Timothy S. Hillier, P.E., CFM. Coastal Process Lead, STARR, August 19, 2010 http://panels.floodsrp.org/files/?artifact_id=2637.
- 2007 Guidance of Atlantic and Gulf Coast of the US, http://www.fema.gov/library/viewRecord.do?id=2458.

August 29, 2011 Request for Clarification from FEMA's Contractor – Clarify statement made by FEMA's Contractor during August 16 Oral Presentations inconsistent with the footnote appearing on page D.2.7-3 of the 2007 Guidance of Atlantic and Gulf Coast of the US.

- Clarification provided by Timothy S. Hillier, P.E., CFM. Coastal Process Lead, STARR, September 28, 2010 http://panels.floodsrp.org/files/?artifact_id=2622 .

Guidelines Reviewed By Panel

Federal Emergency Management Agency, *Map Modernization Guidelines and Specifications for Flood Hazard Mapping Partners* http://www.access.gpo.gov/nara/cfr/waisidx_02/44cfr67_02.html:

- *Appendix D – Guidance for Coastal Flooding Analyses and Mapping*, Washington, DC, April 2003 http://panels.floodsrp.org/files/?artifact_id=2640.
- *Volume 1 – Flood Studies and Mapping*, Washington, DC, April 2003 http://panels.floodsrp.org/files/?artifact_id=2641.

National Flood Insurance Program, *Code of Federal Regulations, Title 44, Chapter I, Part 67 - Appeals from Proposed Flood Elevation Determinations*, Washington DC, http://www.access.gpo.gov/nara/cfr/waisidx_02/44cfr67_02.html.

Federal Emergency Management Agency, *Scientific Resolution Panel Review Guidelines*, Washington, DC, January 23, 2011 http://panels.floodsrp.org/files/?artifact_id=2643.