Incorporating Risk-Informed Decision Making for Flood Risk Management Studies
Planning CoP Webinar
August 16, 2018
Q&A Session

Mr. Eric Thaut, Deputy Director, Flood Risk Management Planning Center of Expertise (FRM-PCX); Mr. Nick Applegate, Economic and Risk Analysis Chief, Sacramento District; Mr. Peter Blodgett, PE, Senior Hydraulic Engineer, Sacramento District; and Ms. Sara Schultz, Water Resources Planner, Sacramento District provided an overview of the Inland Flood Risk Management (FRM) business line. The webinar addressed business line specific policies and guidance relevant to FRM studies, as well as common challenges and risks in FRM. The presentation discussed conducting iterations of risk-informed planning in an FRM feasibility study, and focused on specific economics and hydraulics considerations in FRM.

For more information about the Inland FRM business line:

- *USACE Flood Risk Management Gateway Site*
- *Planning Center of Expertise for Flood Risk Managaement SharePoint*
- *Flood Risk Management Guidance Collection on the Planning Community Toolbox*
- *USACE Institute for Water Resources (IWR) Flood Risk Management Program Website*

This summary of the Question / Answer session of the webinar is not a transcription; questions and responses have been edited and reordered for clarity.

FRM Tools, Data, and Modeling

What is the time and cost associated with using the USACE Hydrologic Engineering Center's life loss and direct damage estimation software (HEC-LifeSim)?

HEC-LifeSim is the most robust life-loss tool that we have, which is used for complex analysis where greater fidelity is needed for decision making. HEC Flood Impact Analysis (HEC-FIA) is still a detailed model, but has some simplifying assumptions that LifeSim doesn't (e.g., straight line evacuation vs. using the actual road grids). HEC-LifeSim or HEC-FIA would be applicable for an FRM feasibility study where life loss is a significant concern; the choice of which software to use would depend on the study needs. Lastly, the levee screening tool (LST) is used for broad scale, low fidelity evaluation primarily for comparison purposes (e.g., initial screening of the USACE inventory of levees for the Levee Safety Program Inventory and Review effort).

Time and effort for HEC-LifeSim will vary quite a bit based on a lot of different factors, such as the study area size and complexity, the level of information you currently have (vs. what you need to gather), how many events/scenarios you want to run, the expertise of your modeler, etc. The model is fairly scalable in the hands of an experienced modeler. Cost and time requirements can range from $10k-$50k and 2 weeks to a couple months depending on the complexity of the analysis and the availability of existing

information and relevant models. Those interested in more information regarding HEC-LifeSim's capabilities should reach out to Woody Fields at HEC. For more information about the software, visit HEC's website: http://www.hec.usace.army.mil/software/hec-lifesim/.

Is velocity accounted for in the HEC-LifeSim model?

Yes, velocity is accounted for in HEC-LifeSim.

Can you give an example of an FRM study that used HEC-LifeSim and/or HEC Flood Impact Analysis (HEC-FIA, a software tool to help identify the consequences from a single event) modeling for life safety?

The Sutter Basin feasibility study out of Sacramento District is a good example of an FRM study that used HEC-LifeSim. HEC-LifeSim was run for the study area by the Risk Management Center (RMC, which was not part of the study budget) in order to provide more detail on the difference in residual life loss between the National Economic Development (NED) plan* and the Locally Preferred Plan (LPP). This helped support selection of the LPP as the recommended plan and determine whether there was federal interest in "buying up" to the LPP. It was determined that there wasn't, so federal interest was capped at the NED plan.

*For more about the NED plan, see the first question under FRM Plan Selection Considerations.

What is the format of HAZUS data? *(HAZUS is a nationally applicable standardized methodology maintained by FEMA that contains models for estimating potential losses from earthquakes, floods, and hurricanes)*

In its raw form, HAZUS data is in MDB (Microsoft Access) format and can be used in GIS software as a DataBase File/Shapefile. The National Structure Inventory (NSI), which was developed to simplify the workflow for GIS pre-processing for the Modeling, Mapping, and Consequences Production Center (MMC), was largely based on HAZUS data and is available in Shapefile format. Contact Woody Fields at HEC for more information.

Who should be providing hydraulic reaches and index stations for riverine FRM studies? Hydraulics and Hydrology (H&H)? Econ?

The initial assessment should be conducted jointly by the H&H, Geotech, and Economic project delivery team (PDT) members as soon as relevant data (such as maps, topography, and perhaps floodplain information) is available. This could likely happen within the first 90 days, with some revisions expected as the team moves forward and gathers more information building toward more formal modeling of the floodplains (HEC-RAS/RAS-2D, etc.) and economics (HEC-FDA). Plan formulators should also be part of this effort because consideration of potential measures can potentially influence the selection of reaches, index stations, or economic impact areas.

Specifically, the key subject matter experts provide the following information:

- Hydraulics – Select reaches that have similar channel hydrology and hydraulic characteristics. Another goal is to define areas that would have similar sources of flooding. For example, Area 1 is subject to flooding from source A; Area 2 is subject to flooding from source B; Area 3 is subject to sources A and B.

- Geotech – Select reaches or segments that have similar geotechnical performance characteristics.
- Economics – Further divide economic areas into economic impact areas (e.g., if damages should be divided or sub-divided based on city boundaries).

When in the planning process should the analysis for separable elements be performed in formulating an FRM project? Prior to the Tentatively Selected Plan (TSP)?

A separable element is any part of a project which has separately assigned benefits and costs, and which can be implemented as a separate action (at a later date or as a separate project). Potential separable elements should be identified and acknowledged as early in the study as possible; however, the level of analysis for separable elements will vary from study to study and over the course of the study depending on what information is needed to support risk-informed decision making. Analysis of separable elements prior to the TSP may be needed if it is necessary to distinguish between alternatives. If not, detailed analysis may not be required until after the Agency Decision Milestone (ADM), when refining the recommended plan.

Often, separable elements are associated with defined damages areas in the study that are hydrologically separable areas. These separable areas need to be determined by the entire team (primarily H&H, Economics, Geotech and Plan Formulation) as early in the study as possible. Typically, this occurs soon after the Alternatives Milestone, particularly if you are going to conduct HEC-FDA modeling. Initial identification of hydrologically separable areas can be accomplished using topographic maps and professional judgment and experience and refined as more detailed information becomes available. Additionally, PDTs should plan for change so that models and technical analyses can be re-run in the future with different information if need be.

Is there policy describing how far out the tails of the distribution go when considering the "full range" of flows?

What we really mean by full range of flows is the full range of different flood magnitudes, which of course isn't an absolute full range. Standard practice is to focus on events up to approximately a 0.2% (1/500) Annual Chance Exceedance (ACE) because the probability of damages associated with larger (less frequent) events becomes so small that we may consider it to be negligible in terms of annualized damages. However, in a highly urbanized area, a less frequent event (e.g., 0.1% (1/1000) ACE) could also be included in that range because of the high consequences.

How do you get the depth-mortality information?

Depth-mortality information is based on empirical evidence, but there's limited data out there and a great deal of uncertainty in these curves. You can contact the HEC (Woody Fields) for more information, or even take one of the HEC-FIA PROSPECT classes HEC offers!

Are you going to cover how PDTs can consider use of these tools (i.e., HEC-FIA, LifeSim) to analyze an array of alternatives in a limited time/funding/scope manner?

Assuming the question is regarding life safety modeling tools – we were unable to provide these details due to time limitations and the scope of this webinar. However, the use of these tools should be considered if life safety is a significant aspect of a study. The FRM-PCX and HEC can provide assistance in selecting and applying these tools.

Do we have tools to produce the economic tables and charts shown in the presentation?

Yes, we do have the tools to gather the necessary data to produce the economic tables and charts. You will likely need to utilize a Monte Carlo Excel add-on program called @Risk (developed by Palisade) to plug in uncertainty results from HEC-FDA and the Cost and Schedule Risk Analysis in order to come up with some of the benefit-cost ratio numbers and net benefit ranges and probabilities.

FRM Plan Selection Considerations

What does the NED Plan stand for?

NED stands for "National Economic Development;" the NED plan is the plan that reasonably maximizes net NED benefits. NED is the change in economic value of the national output of goods and services and is one of the "Four Accounts" we use to evaluate and display the effects of the alternatives. The other accounts are: Regional Economic Development (RED) which looks at the changes in the distribution of regional economic activity as a result of the plan; Environmental Quality (EQ) which assesses the non-monetary effects of our projects on the environment; and Other Social Effects (OSE) which displays the effects of our projects that are not captured in the other accounts. Additional detail on the accounts can be found in ER 1105-2-100, Planning Guidance Notebook.

Is it correct that an FRM study can be justified based on life loss, even if there are not positive net annual NED benefits? If so, is there guidance available on this issue?

The short answer is yes, non-NED plans may be justified, but it doesn't happen often and the justification needs to be clear and compelling. Justification of plans based on life loss risk reduction is most common in the dam and levee safety programs. For traditional feasibility studies, it is more common that a NED plan is identified, but a different plan is recommended to address residual life loss risk associated with the NED plan.

The Sutter Basin study is an example of this – where the NED plan turned out to be the federally supported plan, but the sponsor preferred a different plan due to the residual life safety risk associated with the NED plan. There could also be compelling reasons beyond life safety, such as social justice or environmental concerns, which could be added onto the "Federal Plan" discussion beyond NED. Within the Planning Guidance Notebook, there is guidance on how to provide justification for selecting the LPP over the NED, including factors related to life safety. Specifically, Appendix D of ER 1105-2-100, Economic and Social Considerations has been updated and will be posted soon to the Planning Toolbox.

If life safety is used to justify a higher cost plan than the NED plan, is the plan an LPP or can a plan that also addresses life safety be the agency preferred plan? How is cost share determined if there are good reasons to recommend a plan other than the NED plan?

It can be either, depending on the situation. There are certainly cases in which we've chosen the higher cost plan and there will be situations in the future where life safety warrants a higher federal investment. See response to previous question.

Cost sharing would depend on what is identified as the "Federally Supportable Plan" from an investment standpoint. If federal interest beyond the NED is justified, then cost share could be based on the higher cost plan. But again, this hasn't happened very often, historically.

What percentage of landowner participation makes non-structural measures a viable alternative?
Planning Bulletin 2016-01: Clarification of Existing Policy for USACE Participation in Nonstructural Flood Risk Management and Coastal Storm Damage Reduction Measures provides guidance on this issue.

Each study is unique, and what constitutes a viable alternative plan will depend on the specific details for each study area and plan. For the Sacramento District Sutter Basin and Lower San Joaquin River studies non-structural measures appeared to be more viable where there would be low density infrastructure with frequent flooding. For the Sacramento District Cache Creek study it appeared to be more viable where there was a high concentration of damages in a couple of buildings, but relatively shallow flood depths. In general, non-structural measures, such as floodproofing and home raises, are more likely to be economically feasible when the flooding is frequent and relatively shallow (three feet or less).

Note: The National Nonstructural Committee (NNC) is currently being re-established under a new charter. For any non-structural related questions, please contact Lea Adams at HEC or Eric Thaut at the FRM-PCX.

Does the Water Resources Development Act of 1990 (WRDA 90) limit towns, cities, and metropolitan areas from developing in the floodplain?
It does not; however, there are FEMA regulations and other local ordinances that jurisdictions must follow when developing in the floodplain. Section 308 of WRDA 90 limits what can be considered in the NED benefit-cost analysis associated with structures in the "regulatory floodplain," which is often shorthand for the 1% (1/100) ACE floodplain where flood insurance may be a requirement through FEMA's National Flood Insurance Program (NFIP). The FEMA NFIP Study Guide and Desk Reference for Local Officials provides an excellent overview of the program, history, and legal limitations.

Is the "regulatory" floodplain defined by FEMA or the Corps?
The regulatory floodplain is administered by the FEMA NFIP. USACE can conduct floodplain studies to inform identification of regulatory floodplains; however, they must go through a technical and public review process administered by the FEMA NFIP before they can become regulatory floodplains.

We may develop our project based on expected performance, but when our local partner is conducting OMRR&R (operation, maintenance, repair, replacement, and rehabilitation), we must evaluate the project in terms of level of performance, correct?

During our studies we certainly want to consider OMRR&R and how critical that aspect of the project is to our decision making (e.g., looking at a plan that has acceptable outcomes and few OMRR&R requirements vs. a plan that provides increased risk reduction but also increased OMRR&R requirements).

When we try to obtain information about the area from prior studies, should we look at no action and alternative actions generated from historical studies in general?

We always have a no action plan, and we also take into account the future without project conditions as the baseline. We definitely want to pull from ideas or alternatives that were identified in earlier studies; depending on the source of those studies or how much time has elapsed, they may be in need of reevaluation. If the conditions are still the same, we can potentially take those ideas or alternatives into account; however, we still need to ask the question about why a certain measure wasn't selected at the time.

What are the important legal or technical aspects of a shovel ready (vs. non-shovel ready project)? Does it depend on urgency? Or, does it depend on sponsor participation, or type of project? And, if any of these measures are the case, why would shovel as compared to non-shovel ready projects vary in cost?

This is a very dynamic program/portfolio type question that doesn't really have one specific answer. Generally, our job is to serve the Nation in reducing flood risk, and when we can do that and a project is shovel ready, it just means we can do our job more quickly.
Cost will differ depending on the study. Most of our studies would not be considered "shovel-ready" because they are in the "feasibility phase" where we are determining the best investment of federal funding by going through the planning process. We should include information from prior studies, but submit all of the alternatives to a consistent level of analysis by incorporating the alternatives from previous studies into our process and not just accepting them as is.

Shovel ready projects would generally be projects that have already gone through the feasibility phase and the Preconstruction, Engineering, and Design (PED) phase and are ready for the construction phase. Prioritization of construction for multiple shovel ready projects would depend on a lot of factors, but it could include sponsor participation and urgency as mentioned in the question. Some other factors could include availability of resources, environmental impacts, risk prioritization, and much more.

During the feasibility phase, we generally have a limited level of detail and therefore the cost of a measure or alternative includes a contingency in order to account for the level of uncertainty associated with the alternative. Once the plan has completed the feasibility and PED phases, we have more certainty as to the cost of the plan and the contingency percentage is reduced. So, assuming that "shovel ready" means that the project is through PED and ready to award a contract and "non-shovel ready" hasn't been through PED, the shovel ready costs should have less variability.

If a nonstructural measure takes less than a year for construction, do you still have to calculate interest during construction?

Yes, and there are multiple ways to do it. Some might say there is no Interest During Construction (IDC), but that's not technically correct. The standard is usually to calculate IDC annually at the mid-year, but in

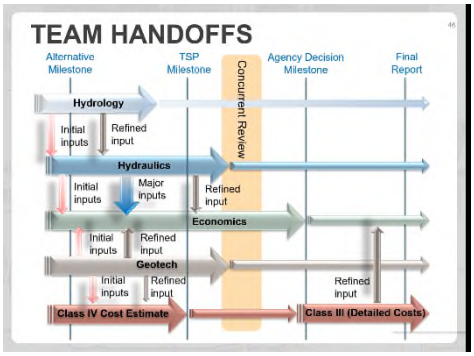
this case you could also calculate it monthly if needed. The bottom line is that the IDC should be relatively insignificant for a study with only a year of construction, especially at the low current federal discount rates.

FRM Study Process

What best practices do you recommend for incorporating stakeholders and citizens in aggressive study timelines?

Taking time to talk/listen to concerned citizens and stakeholders, and ensuring we have their feedback and meaningfully incorporate it into the planning process is key. Incorporating stakeholders in the study area requires networking and establishing relationships with the sponsor. That will help you reach out to other agencies and groups in the watershed. A lot of time and energy can be saved if a successful sponsor relationship is used as a conduit for local input.

The "team handoffs" graphic doesn't take National Environmental Policy Act (NEPA) considerations into account.



The graphic was meant to be illustrative of key handoff points, with a focus on the disciplines discussed in this presentation (e.g., H&H, Econ, etc.); however, environmental compliance touchpoints should be included. A revised graphic will be included in the Inland FRM risk-informed decision making placemat that is being developed as a companion reference to the presentation.

Any recommendations on how and when to deal with transferred or transformed flood risk? Are there any best practices to address potential induced impacts during feasibility and beyond (such as construction)?

Typically, when we're using our H&H and Economic models during the TSP phase and beforehand to evaluate different plans, we look at residual floodplains (the remaining floodplain after an alternative is implemented) as part of the analysis.

Regarding transferred flood risk, the risk should be recognized and acknowledged while the team is working towards the TSP. If the risk isn't critical, then the team can likely return to it after the ADM. However, the answer will vary depending on the study and the risk. However, if the transferred flood risk does appear to be critical, then a Real Estate takings analysis should be conducted prior to the ADM and measures should be considered to address the transferred risk.

When should optimization occur relative to the milestones?

The answer comes down to the study in question. "Optimize" is a tricky term, because it means different things to different people. Study teams should consider the scale of their problem, risks, and potential solutions from Day 1. For example, a solution that might work to manage more frequent, lower

magnitude floods may differ significantly from a solution to manage less frequent, larger magnitude floods. Optimization should continue to occur throughout the process as the study team continues to make each subsequent decision and recommendation. More specifically, there is usually some amount of optimization (fine-tuning) after the TSP moving toward the ADM and final report based on feasibility level design and review comments.

Does the Level 3 cost estimate after ADM only apply to the TSP, or should we revisit all alternatives?
ER 1110-2-1302 Civil Works Cost Engineering provides guidance on this topic. Additionally, there is a PCoP webinar that covers cost guidance, cost basics and terminology, and cost share ratios. Generally, the requirement for the final array of alternatives and TSP is a Class 4 cost estimate. The plan put forth as the study team's final recommendation needs to have the Class 3 cost estimate. However, the bottom line is that the study team needs enough detail to get to the next decision and move forward; whether that means a Class 3 or Class 4 cost estimate is needed should be determined by the study team. If the recommended plan happens to be an LPP plan, then there would also have to be an equally detailed cost estimate for the NED Plan.

Is there a size/complexity limit on the 3x3x3 SMART planning process?
It's generally recognized that "one size doesn't fit all" and the WRRDA language on 3x3 lays out criteria for complex and large studies/projects. For example, vertical teams have already made recommendations at the start that studies be exempt from the 3x3x3 policy for very large, complicated study areas. Our job as PDT members is to spend the first 90 days and beyond laying out those instrumental uncertainties, decision risks, and risk drivers in order to give decision makers the risk information they need to be able to make determinations about moving forward (e.g., about whether a study will realistically meet the 3x3x3 policy).

Do you have any examples of when new data had to be collected prior to selecting a TSP? For the large-scale studies, stakeholders and resource agencies have been questioning the screening of alternatives and selecting the TSP using only existing data (and not accepting the risk).
We routinely develop new or revised floodplain data and revised economic benefits prior to the TSP, which inform the TSP selection. It may be less detailed than what we've done in the past – and there are certainly resource agency concerns about this decreased amount of data – but the TSP is ultimately informed by multi-model output (i.e., hydraulics and economics). It is critical that data collection be targeted to buy down risk in areas of significant uncertainty, as blanket data collection is no longer the norm in risk-informed planning.

PDTs should also keep in mind that storytelling is critical. We often have good stories to tell that may have less detail and fewer data points.