

FLOOD RISK MANAGEMENT – PLANNING CENTER OF EXPERTISE (FRM-PCX)

FRM-PCX WEBINAR SERIES

#6

INCORPORATING LIFE SAFETY IN FRM PLANNING STUDIES

Prepared/Presented by Kendall Zaborowski and Nick Applegate

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FRM-PCX – WE'RE HERE TO HELP!!!

...BUT WE NEED YOUR HELP TOO!

➤ **The Goal:**

- Timely webinars on specific topics that can help you and your FRM study RIGHT NOW!
- Provide individual presentations/training to teams on specific topics relevant for your FRM study
- Provide individual support to teams to help work through specific FRM challenges



Nick Applegate, Nicholas.J.Applegate@usace.army.mil
Eric Thaut, Eric.W.Thaut@usace.army.mil



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PRESENTATION SUMMARY – LIFE SAFETY IN FRM PLANNING

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- **The “so-what”:** Managing risks to human lives is a fundamental component of flooding and FRM Planning
- **Policy/Guidance:** Over the next year (or so), new policy/guidance will provide more detail through construction
 - Planning Bulletin 2019-04, EC and ECB
- The goal of this presentation is to answer the following questions:
 - Why is life safety important in FRM Planning?
 - What do you need to know about Life Safety Risk?
 - What are Tolerable Risk Guidelines, why are they important and how do I use them?
 - What’s the difference between Incremental Risk and Total Risk?
 - What are some of the best practices I can use to incorporate Life Safety into my Planning study?
 - What’s the right level of detail and analysis for my study?



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PURPOSE / WHY NOW?

- Planning Bulletin 2019-04 (Incorporating Life Safety into Flood and Coastal Storm Risk Management Studies)
- Draft EC 1165-2-218 (Levee Safety EC)
- Draft ECB (Risk-informed Design)
- ER-1110-2-1156 (Dam Safety Policy and Procedures)
- 21 Jun 2017 Dalton Memo
- ASA(CW) and the OMB are asking for this information
- Its good planning!



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WHAT DO I NEED TO KNOW?

Its always been good practice to incorporate life safety risk, we just haven't always done it well

➤ PGN – Chapter 2-3, The Planning Process:

(4) Section 904 of the Water Resources Development Act of 1986 (WRDA of 1986) requires the Corps to address the following matters in the formulation and evaluation of alternative plans:

- **Protecting and restoring the quality of the total environment.**
- **The well-being of the people of the United States**
- **The prevention of loss of life.**
- **The preservation of cultural and historical values**

➤ PGN, Chapter 3-3, Flood Damage Reduction:

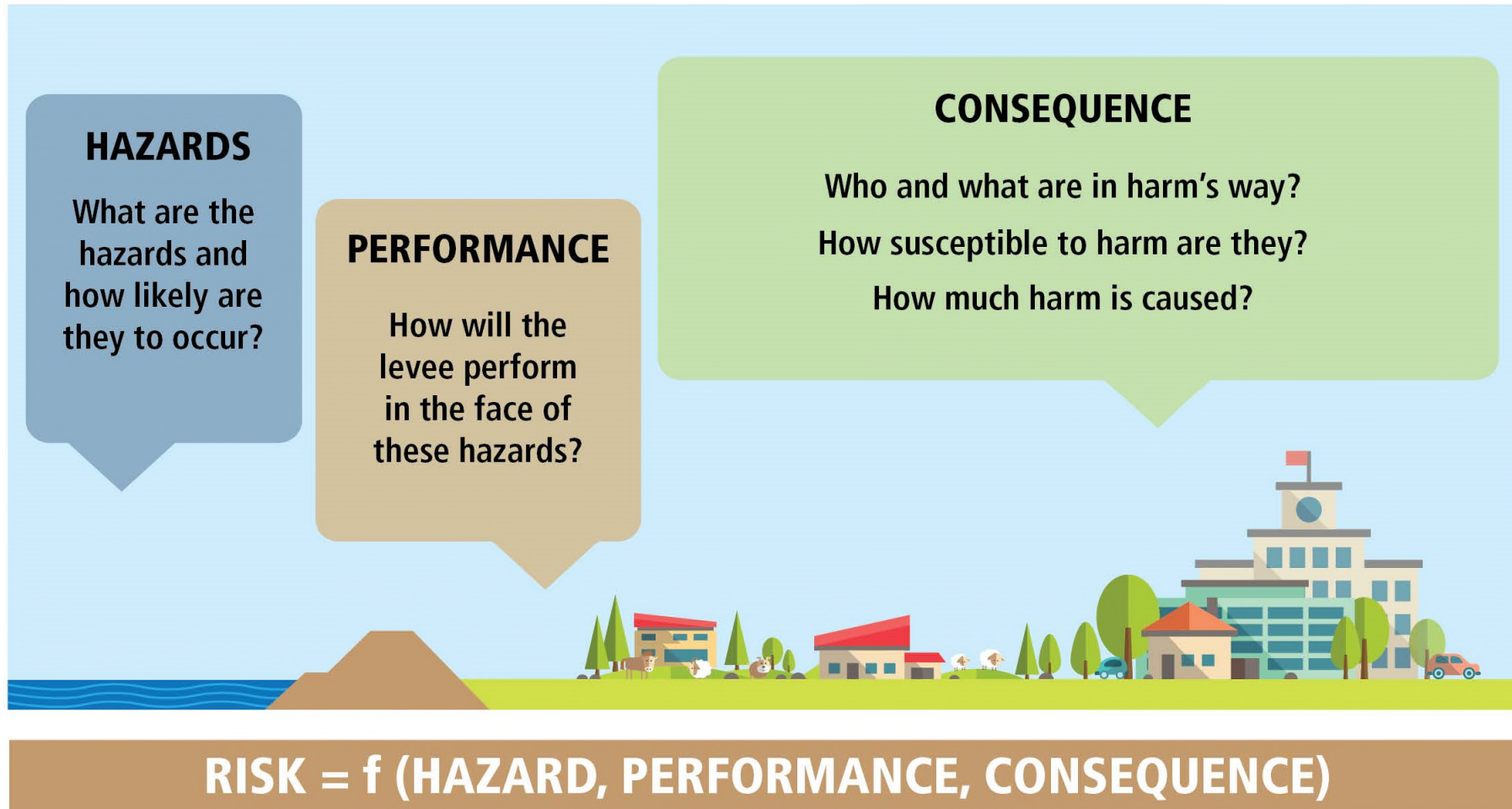
(11) ... **An essential element of the analysis of the recommended plan is the identification of residual risk for the sponsor and the flood plain occupants, including residual damages and potential for loss of life, due to exceedence of design capacity. ...**



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THE FULL FLOOD RISK EQUATION



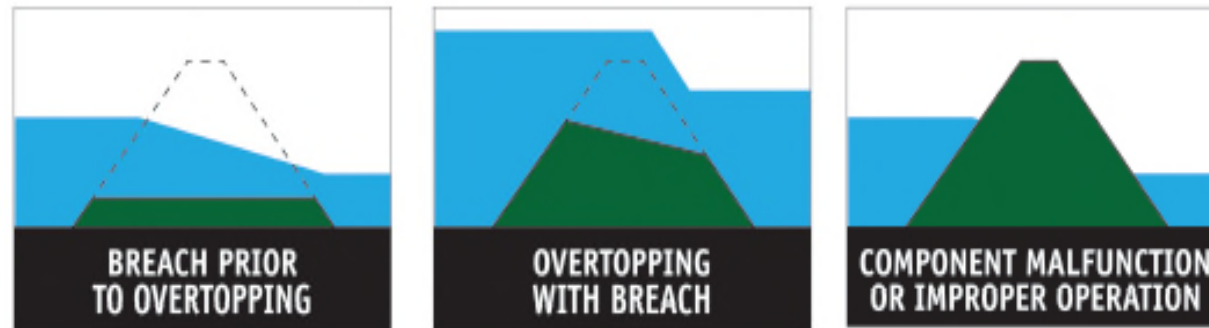
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FLOOD RISK VS. INCREMENTAL RISK VS. NON-BREACH RISK

Flood Risk – The risk at any point in time

Incremental Risk – risk to the floodplain/downstream occupants that can be attributed to the presence of the levee or dam



Non-breach Risk – The risk in the floodplain/downstream area even if the levee or dam functions as intended



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EXTREMELY BASIC EXAMPLES OF LIFE LOSS CALCULATIONS

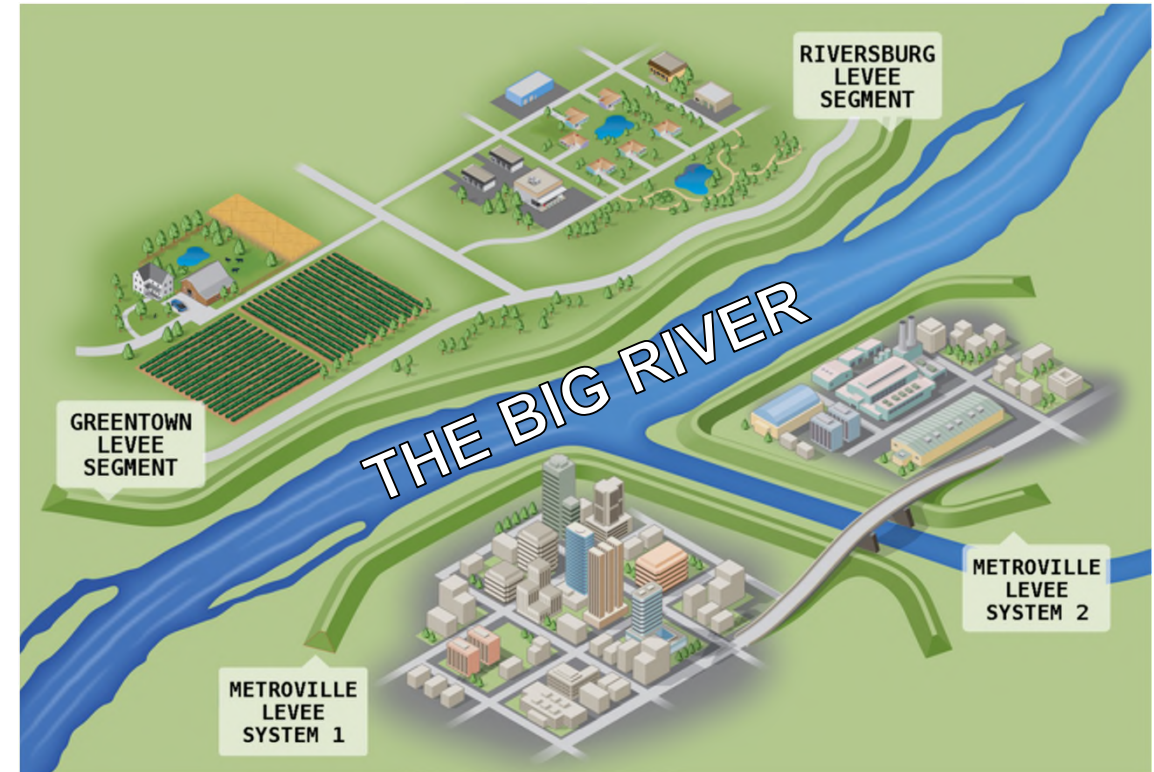
The Big River floods and overtops the Metroville Levee Systems in the surrounding community.

The Metroville Levee Systems perform as designed, but there are 10 lives lost.

- What is the Incremental Life Loss?
- What is the Total Life Loss?

The Riversburg Levee breaches before being overtopped, and 5 lives are lost. The levee would not have overtopped if it had not breached.

- What is the Incremental Life Loss?
- What is the Total Life Loss?



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WARNING!



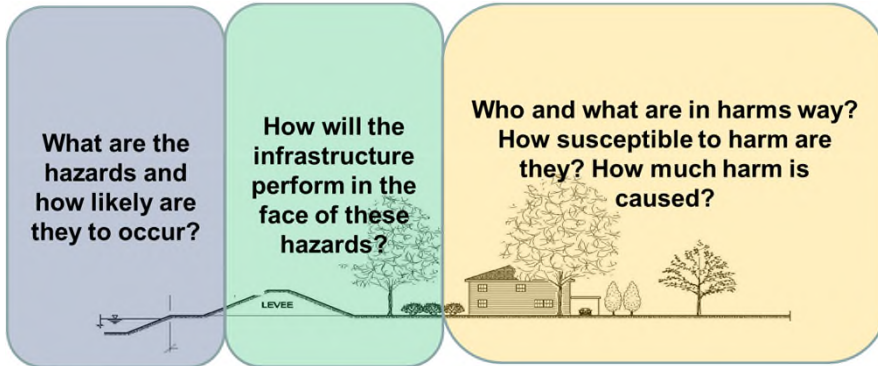
What you are about to see
(next 3 slides) applies to
INCREMENTAL RISK only



TOLERABLE RISK GUIDELINES (TRG)

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TRG 1 - Understand the Risk



TRG 2 – Build Risk Awareness



TRG 3 - Fulfill Day-to-Day Responsibilities



TRG 4 - Manage and Reduce Risk

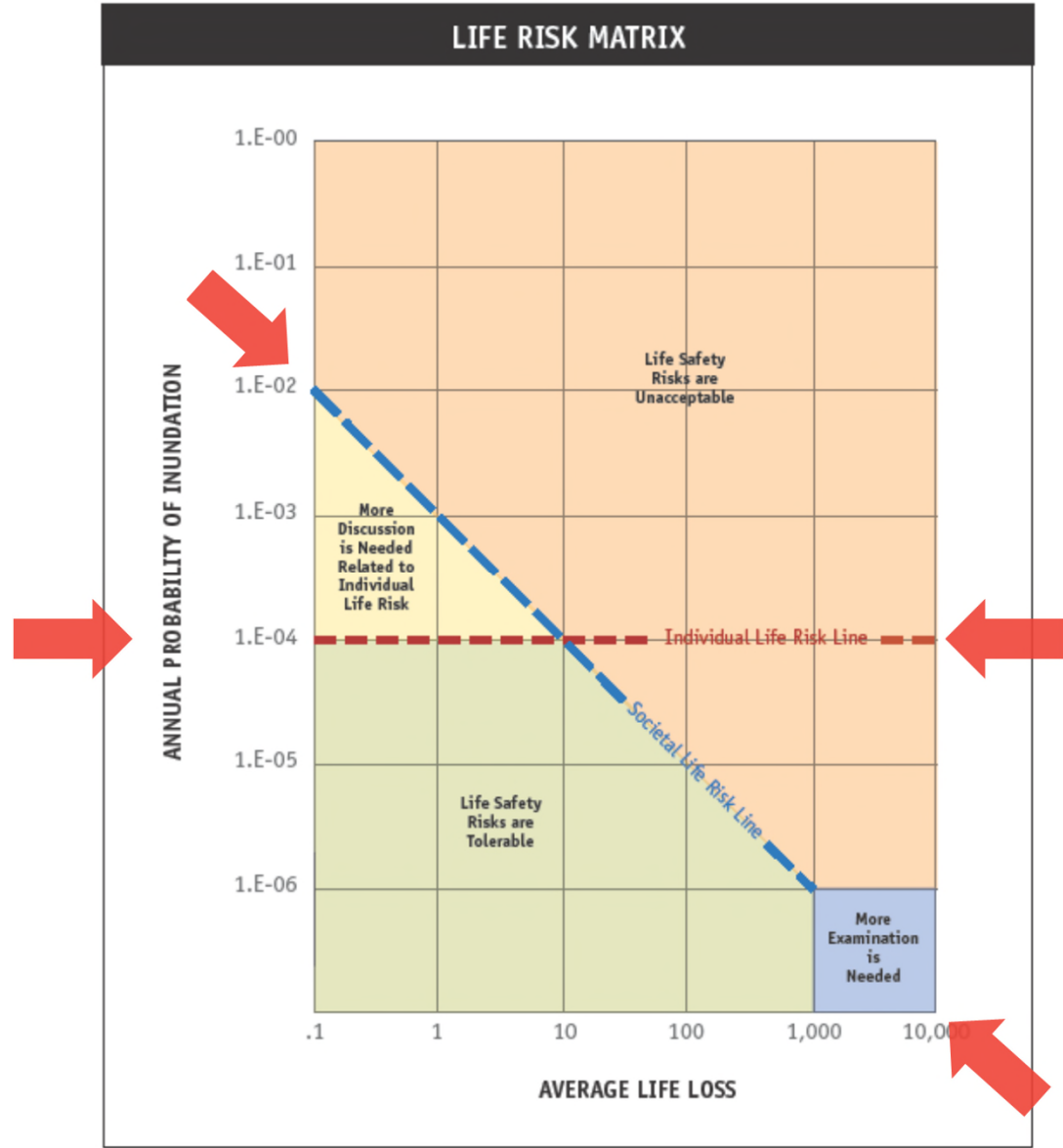


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TOLERABLE RISK GUIDELINE 1

What do we need to do to hit those lines?



Notation Cheat Sheet

Ratio	Decimal	Scientific
1	1	1.00E+00
1/10	0.1	1.00E-01
1/100	0.01	1.00E-02
1/1,000	0.0001	1.00E-03
1/10,000	0.00001	1.00E-04
1/100,000	0.000001	1.00E-05
1/1,000,000	0.0000001	1.00E-06

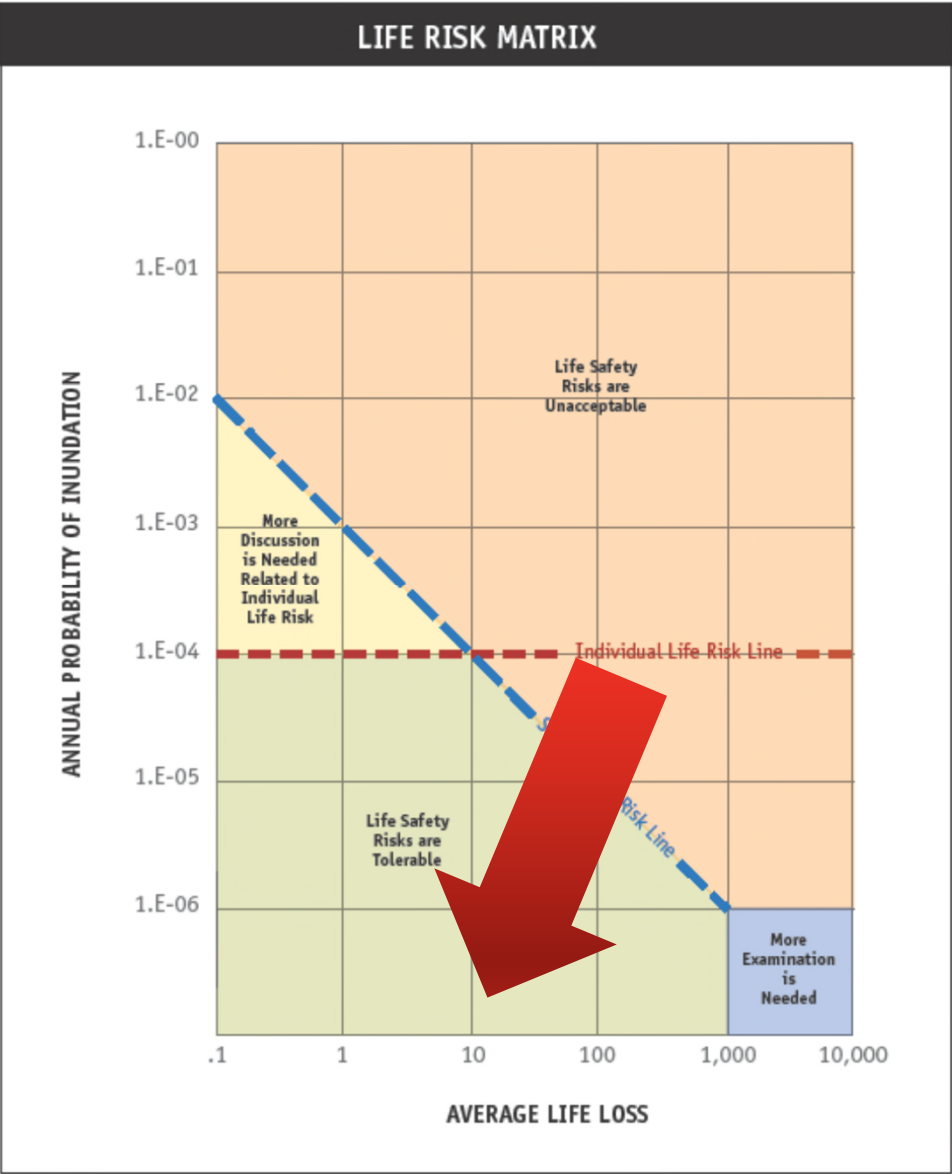


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TOLERABLE RISK GUIDELINE 4

Are there any effective and efficient actions that we can take to continue to reduce risk **As-Low-As-Reasonably-Practicable?**



Often determined by professional judgment



QUIZ

1. Tolerable Risk Guidelines apply to:

- a. Flood Risk
- b. Incremental Risk
- c. Non-breach Risk
- d. All of the above



2. When are risk considered tolerable?

- a. When you're below those dashed lines that were just on the screen.
- b. When you meet all 4 Tolerable Risk Guidelines (TRGs)
- c. When the partner agrees to the recommended plan/says so



BEST PRACTICES FOR INCORPORATING LIFE SAFETY INTO FRM PLANNING

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All studies:

- Identify potential risks to life safety in the **problems, opportunities, and/or objectives**, as appropriate, *early in the study*.
- **Floodplain Management Plan**
 - Encourage early development by Non-Fed partners
 - Should include **Emergency Action Plan**
- Level of detail in **data collection and modeling** efforts should be commensurate with the uncertainty, complexity of the problem and cost of addressing risks.

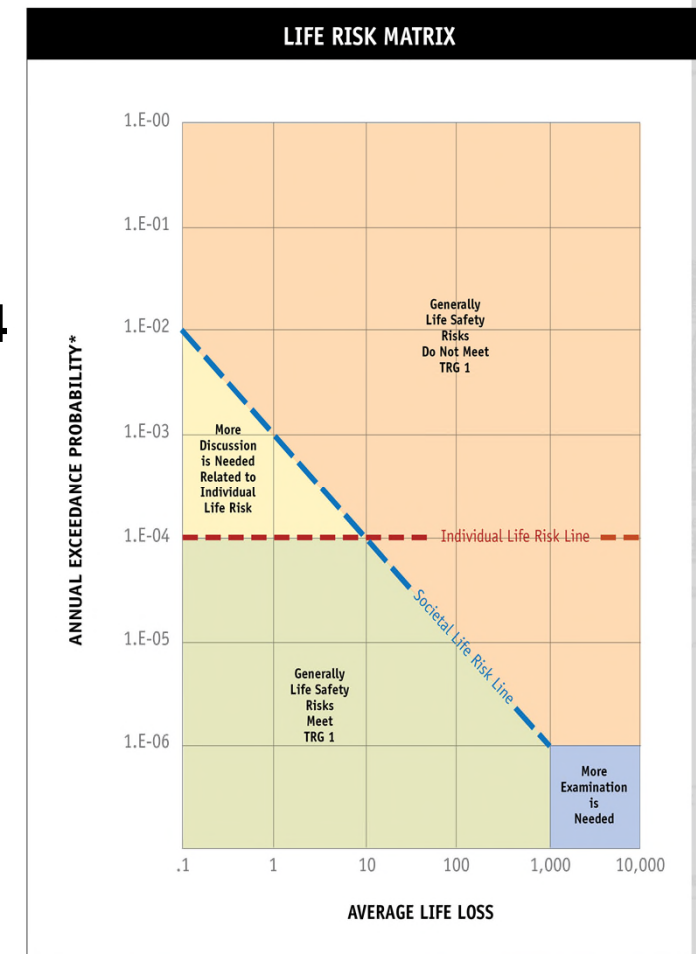


BEST PRACTICES FOR INCORPORATING LIFE SAFETY INTO FRM PLANNING

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Studies with existing and/or proposed Levee Systems and Dams:

- Must consider **incremental risk**
- Goal is to achieve all 4 TRG's
 - PDT should include specific objectives regarding achieving TRG's
 - **One alternative must be identified that addresses TRG's 1 and 4**
- **If new levees or dams are recommended, a life safety risk assessment on the TSP is necessary.**
- Modifications to existing dams or levees require **coordination of the relevant senior oversight group (SOG)**
- Planning and Dam/Levee Safety must coordinate and communicate vertically and horizontally!
 - PDT must assure **engagement of district Levee Safety Officer/Dam Safety Officer and Levee Safety Program Manager/Dam Safety Program Manager** throughout the study.



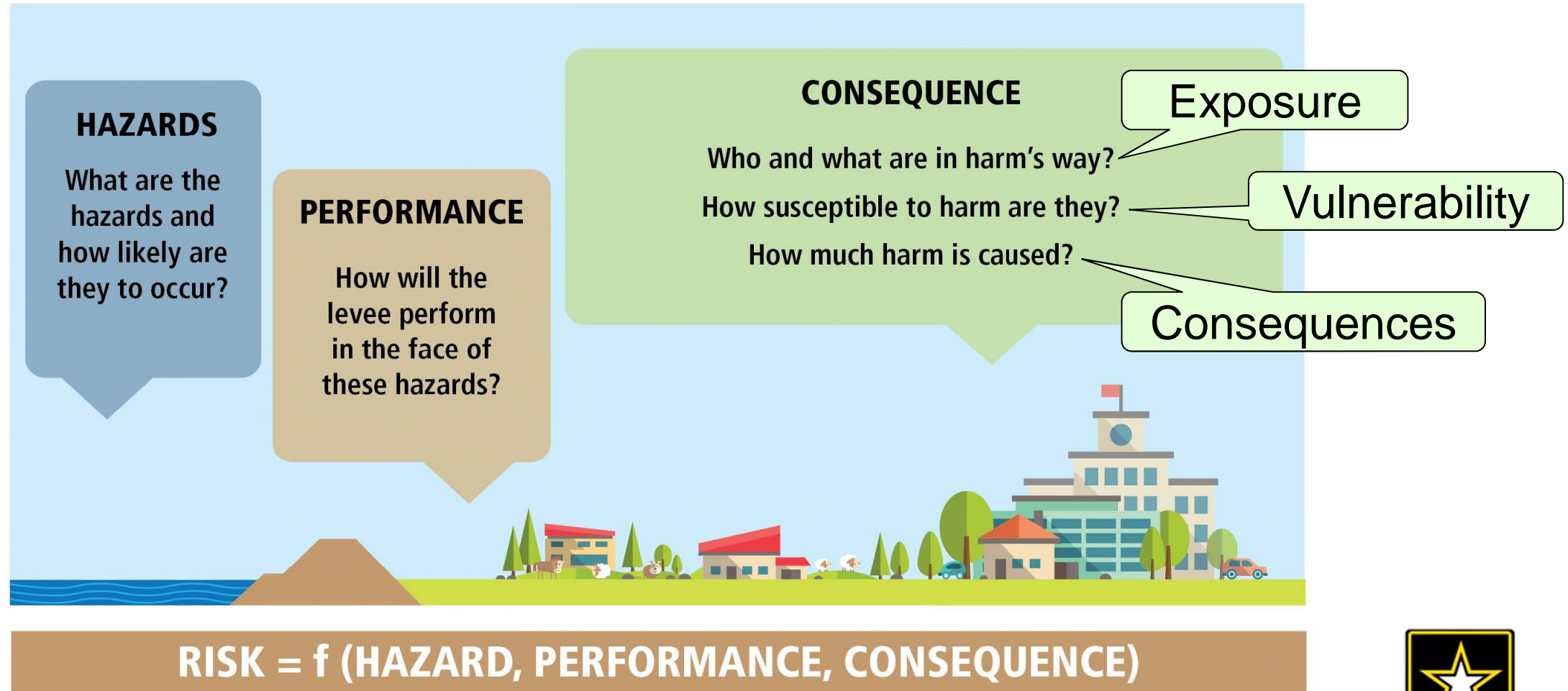
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LIFE SAFETY METRICS – START BY UNDERSTANDING THE FULL FLOOD RISK EQUATION

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- Focus on ALL aspects that affect life, health and safety of the vulnerable population



KEY INDICATORS OF HIGH RISK

- Flood Patterns
 - Arrival times, depth, velocity
- Low Warning Times
- Limited evacuation
- Populations – Vulnerability
- Failure Modes (Levees/Dams)
- Shelter proximity and quality
 - Evacuation distance



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LIFE SAFETY METRICS – THE GOOD, THE BAD AND THE UGLY

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The Bad and the Ugly:

- Population at risk (PAR)
 - Measures only exposure while ignoring vulnerability, consequences and probability
 - A piece to the puzzle, but not a complete standalone metric
- Number of Evacuation Routes
 - By itself, this doesn't tell the evacuation story related to life safety
 - How many evacuation routes are necessary to safely evacuate the study area based on assumed warning times and evacuation speeds?
- Life loss for single events
- Damages for single events
 - Ignores vulnerability and exposure of population
- Average Flood Depth
 - Ignores vulnerability, geography, velocity, arrival time, etc.



THE GOOD THE BAD AND THE UGLY

LIFE SAFETY METRICS – THE GOOD, THE BAD AND THE UGLY

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The Good:

- Expected annual life loss
 - Historical life loss?
 - Existing LST data available?
 - LifeSim or HEC-FIA analysis
- Population > 2ft flooding; Population > 9ft flooding
- Velocity of flooding
- Rate of Rise
 - Flood arrival times
 - Warning Times
- Socio-economic characteristics of the floodplain:
 - Vulnerability of population above 2ft depth
 - Access & response to warnings
 - Access to transportation for evacuation
- Critical infrastructure above 2ft depth
 - Hospitals, Fire and Police Departments, Schools
- Evacuation risk relative to warning time and baseline safe evacuation
- Warning systems and human response

➤ Choose/create metrics that are most appropriate for YOUR STUDY AREA

➤ What factors would convey the most compelling health and life safety story?



THE GOOD THE BAD AND THE UGLY

WHEN/HOW CAN LIFE SAFETY IMPACT DECISION MAKING?

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- Anytime it's a problem!
- Helps distinguish plans from each other that have similar NED benefits
- Need to intentionally formulate to include life safety
 - Different than considering life safety and then only evaluating based on BCR
 - Don't blindly screen life safety measures solely based on NED
 - Don't formulate for damages/economics and then add in life safety at the end



- Formulate measures that reflect security of life, health, and safety



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LIFE SAFETY MEASURES AND THE FLOOD RISK EQUATION

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INTEGRATED LIFE SAFETY MEASURE/PLAN EVALUATION MATRIX – AN EXAMPLE

Measure	Metric							
	Economic Damage	Expected Annual Life Loss	Flood Velocity Life Loss Risk (LLR)	Warning Time LLR	Evacuation LLR	Vulnerable population > 2ft	Incremental Risk	Cost
No Action	High	High	High	Medium	High	High	Low	--
Relocations	Low	Low	Low	Low	Low	Low	Low	High
Home Raises	High	High	High	Medium	High	Medium	Low	High
Levee	Medium	Medium	Medium	Low	Medium	Low	High	Medium
Bypass	Medium	Medium	Medium	Low	Medium	Low	Low	Medium
Building codes	High	High	High	Medium	High	High	Low	Low
Evacuation Planning	High	Medium	Medium	Low	Medium	High	Low	Low

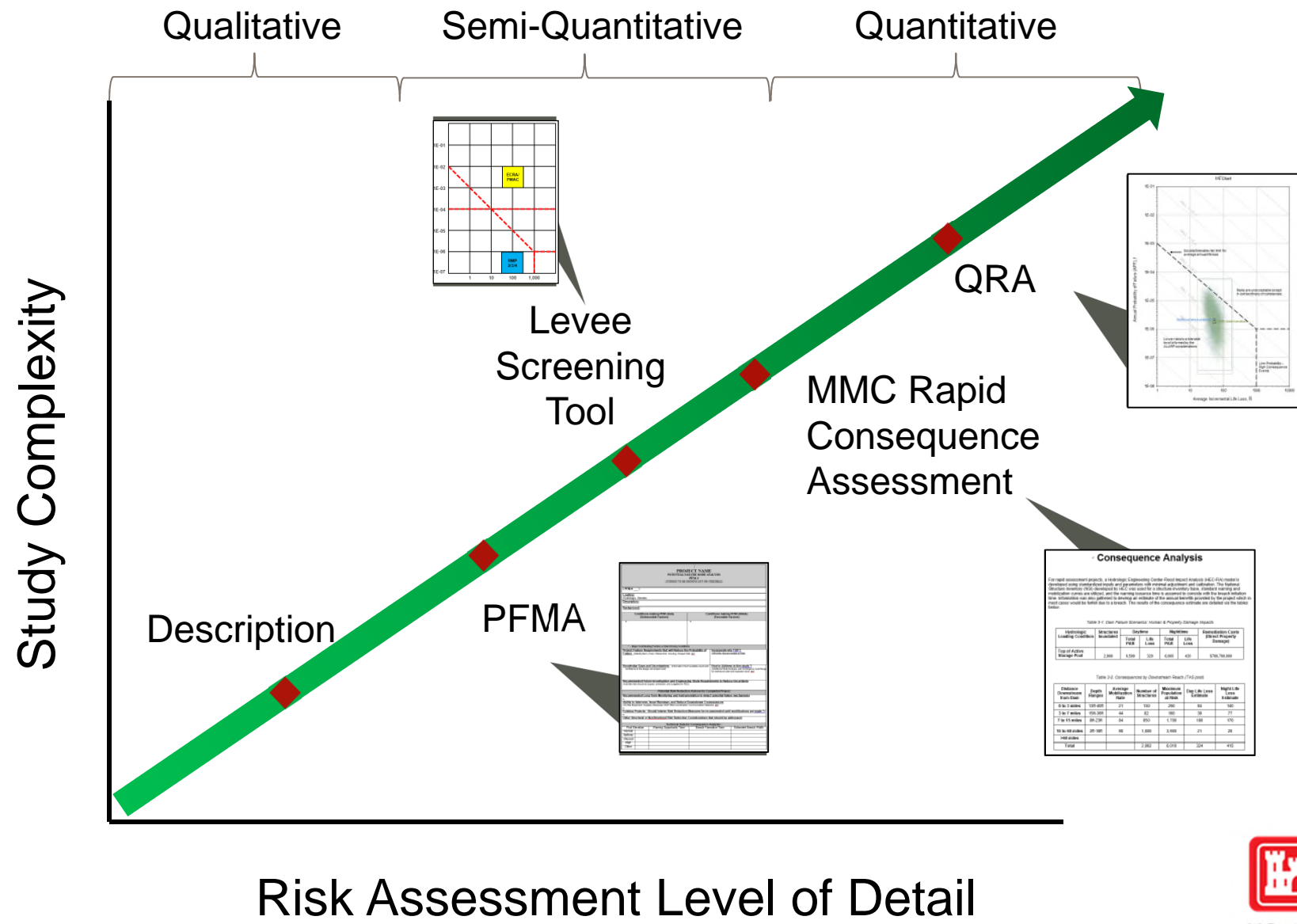
- Compare outputs for similar cost measures/plans
 - Could we screen any measures?
- Can we weight key metrics higher than others?
 - What if most of the life loss has been a result of high velocity flooding?
 - Could we screen any measures?
 - What if most of the life loss has been a result of low warning times?
 - Could we screen any measures?



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FINDING THE RIGHT LEVEL OF DETAIL



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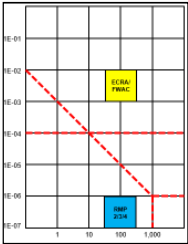
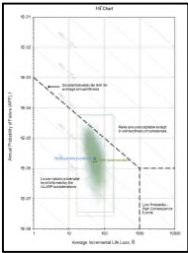
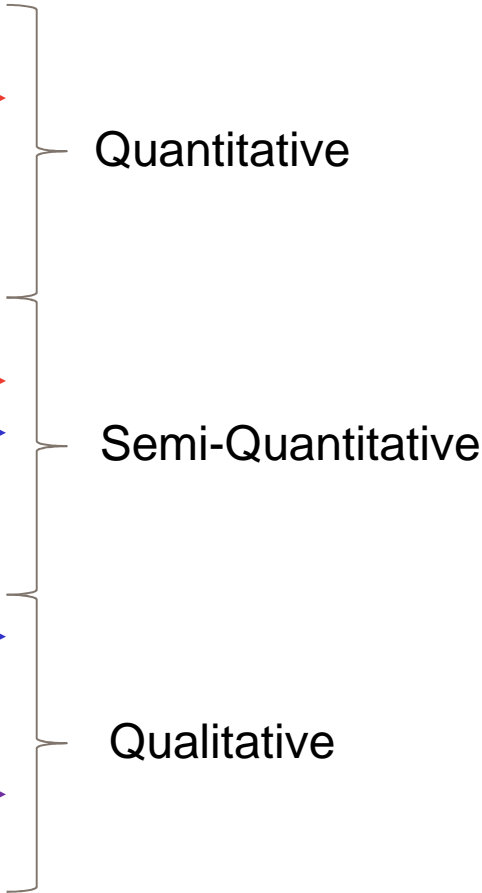
BUT HOW DO I KNOW?

We are considering modifying and existing levee or dam

We are considering building a new levee or dam

We have several indicators of high risk in our study area

We have few indicators of high risk in our study area



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SUMMARY – LIFE SAFETY AND FRM PLANNING

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- **The “so-what”:** Along with specific requirements in PB 2019-04, managing risks to human lives is a fundamental component of flooding and FRM Planning
- **Policy/Guidance:** Over the next year (or so), new policy/guidance will provide more detail through construction
 - Planning Bulletin 2019-04, Draft EC and Draft ECB

Key Takeaways:

- Planning to include life safety is always a good practice and consistent with policy
- Good life safety metrics will incorporate multiple aspects of the Flood Risk Equation, not just one
 - Hazard, Performance, Exposure, Vulnerability and Consequence
 - Metrics should focus on life safety risk drivers for YOUR STUDY AREA. There is no one size fits all!
 - Screening of life safety measures based solely on BCR may NOT be appropriate if life safety risk is high
- If your study has existing dams or levees or proposes new dams or levees, you must incorporate TRG's
 - Incremental Risk is the additional risk imposed by the non-performance of a levees, floodwalls or dams
 - At least one plan must be formulated that achieves TRG's 1 and 4.
 - Must coordinate with Dam and Levee Safety groups throughout formulation
- Life safety assessment level of effort is scalable commensurate with risk and decision making
 - Could this drive decision making? If yes...likely need higher level of detail.
 - Utilize available data where possible (LST, PA's, SQRA's, MMC analysis)



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QUESTIONS / FEEDBACK?

- **Nick Applegate** (FRM-PCX, Economic and Risk Analysis)
 - 916-557-6711, Nicholas.J.Applegate@usace.army.mil
- **Kendall Zaborowski**, (LRH, Dam Safety Modification Mandatory Center of Expertise)
 - 502-650-2618, Nicholas.K.Zaborowski@usace.army.mil



Please contact us with:

- Questions?
- Comments?
- Recommendations for improvement?

FRM-PCX POC's:

- **Eric Thaut**, *Deputy Director*
- **Nick Applegate**, *National Tech Specialist (Economic and Risk Analysis)*
- Regional Managers:
 - **Karen Miller** (*LRD/NAD*)
 - **Michelle Kniep** (*MVD/SAD*)
 - **Charyl Barrow** (*NWD/POD*)
 - **Sara Schultz** (*SPD/SWD*)