LEVEE SAFETY OUTREACH

a Nebraska Silver Jackets Project
in association with the
Nebraska Floodplain and Stormwater Managers Association

Wednesday July 10, 2013
9:00am – 4:30pm

Nebraska City
Nebraska National Guard Building
2020 4th Corso Street

NEBRASKA LEVEE SAFETY OUTREACH

Wednesday July 10th, 2013
9:00 -4:30
AGENDA

Pre-Test, Introductions, Risk Definition

9:00-9:05 Pretest

9:05-9:20 Introductions and the Shared Responsibility of Flood Risk
Shuhai Zheng Ph.D., P.E., CFM (NDNR Head, Floodplain/Dam Safety/Survey Division)

9:20-9:50 Concept of Risk
Tony D. Krause P.E., CFM (USACE FRFMS, NE Silver Jackets Coordinator)

Monitoring and Assessing Risk

9:50-10:35 Levee Failure Modes
Don Moses P.E. (USACE Geotechnical)

10:35-11:05 USACE Levee Safety
Bryan Flere P.E., (USACE Omaha District Levee Safety Program Manager)

Risk Treatments I

11:05-11:50 Mitigation through Transfer and the NFIP
Shandi Teltschik P.E., CFM (FEMA Natural Hazards Program Specialist)

11:50-12:00 USACE and Levee Evaluation for the NFIP
Randy Behm P.E., CFM (USACE FRFMS Chief, National Nonstructural Flood Proofing Committee Chair)

LUNCH 12:00-1:30

Risk Treatments II

1:30-2:00 Mitigation through Probability/Performance Alteration (Structural)
Colleen Horihan P.E., CFM (USACE Flood Risk and Floodplain Management)

2:00-2:30 Mitigation through Consequences Alteration (Nonstructural)
Randy Behm P.E., CFM (USACE FRFMS Chief, National Nonstructural Flood Proofing Committee Chair)

Common Hurdles

2:30-3:00 Common Hurdles - Financial
Marlin Peterman P.E. Papio Missouri River NRD Assistant General Manager

3:00-3:30 Common Hurdles - Real Estate
Amanda Simpson (USACE Realestate Specialist)

3:30-4:00 Common Hurdles - Technical
Lalit K. Jha P.E., D.WRE, CFM Vice President
Water Resources Engineering JEO Consulting

Closeout and Post Test

4:00-4:30 Post-test/Open Discussion / Question and Answer Session

Levee Safety Outreach Workshop

Nebraska Silver Jackets Team
&
Nebraska Floodplain and Stormwater Managers Association

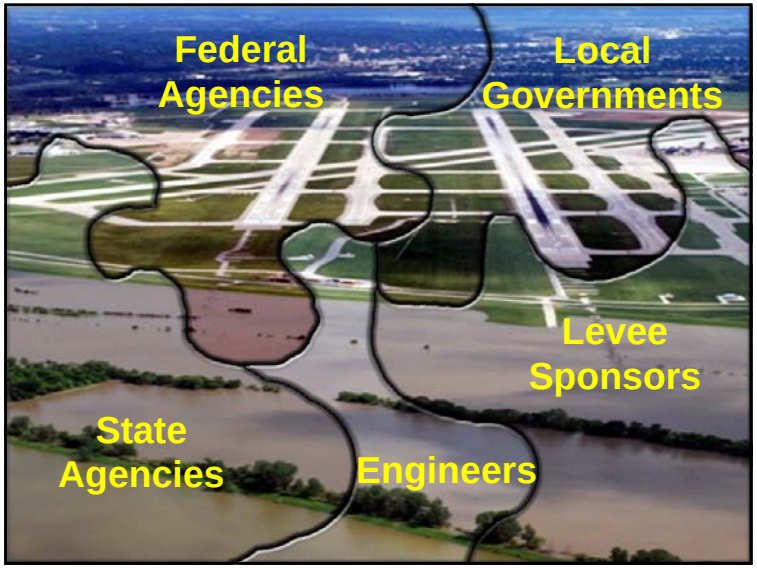
July 10, 2013

Curriculum

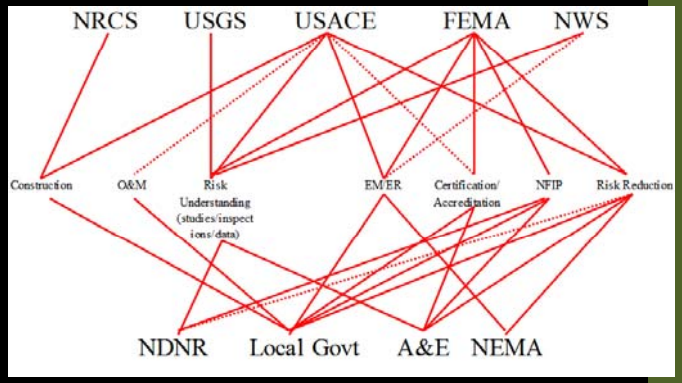
- Introduction
- Levee Risk
- Levee Risk Monitoring & Assessment
- Levee Risk Mitigation
- Common Hurdles
- Drive Home Messages, and
- Many more

Different Aspects of Levee Safety

- Design and Construction
- Operation and Maintenance
- Risk Recognition
- Mitigation
- Emergency Response

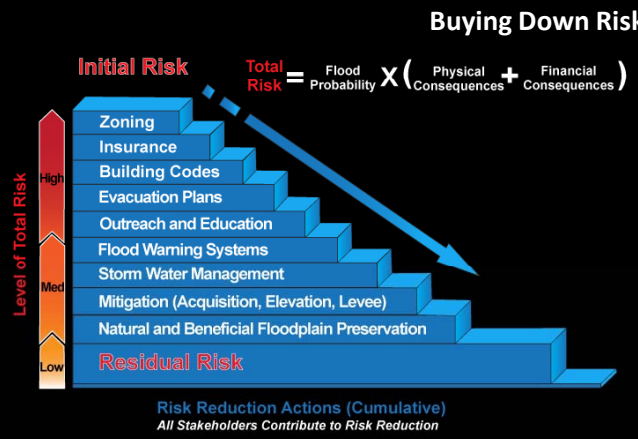


Agency Stick Diagram



Silver Jackets Flood Risk Planning Cycle

Managing Your Total Flood Risk



What is Coming?

- **Water Resources Development Act**
  In May, the Senate passed its version of the act including creation of National Levee Safety Program.
  House ?
- **FEMA's LAMP: Analysis and Mapping Procedures for Non-Accredited Levees. Guidelines are expected to come out in this summer.**

Drive Home Messages

- There are a number of people/agencies involved with flood risk/levee safety
- We all have our own roles
- Levee safety is a shared responsibility

Concept of Risk

Levee Safety Outreach program
July 10, 2013

Tony D Krause PE CFM
Hydraulic Engineer
Omaha District
Slides Prepared: 5/22/2013

US Army Corps of Engineers
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Overview

- Definition of Risk
  - ►Probability
  - ►Consequences
- Risk Examples
- Risk Management Process
- Risk Treatment Options

Definition of Risk

Risk is the **likelihood** of occurrence and magnitude of **consequences**

Risk = f(Probability, Consequences)

Similar definitions are used in other fields
•Occupational Health & Safety Advisory Services: the product of the **probability** of a hazard resulting in an adverse event, times the **severity** of the event
•Finance: Risk includes the **possibility** of losing **some or all** of the original investment
•Food industry: The **possibility** that due to a certain hazard in food there will be an negative effect to a **certain magnitude.**
•Insurance: A situation where the **probability** of a variable (such as burning down of a building) is known but when a mode of occurrence or the actual **value of the occurrence** (whether the fire will occur at a particular property) is not.
•Securities trading: The **probability** of a **loss or drop** in value
•Workplace: Product of the **consequence** and **probability** of a hazardous event or phenomenon.

Table 1. Federal agency definitions of risk.

AGENCY	DEFINITION OF *RISK*
NOAA	The impact of uncertain future events that could influence the achievement of an organization's objectives. Risk directly impacts on the service delivery objective of the organization, because it manifests as the chance of a loss[…]. (Source: "NOAA Risk Management Master," NOAA SECO 10-23-2005.
EPA	[…] EPA considers risk to be the chance of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor. A stressor is any physical, chemical, or biological entity that can induce an adverse response. (Source: {EPA} Risk Assessment Portal http://www.epa.gov/risk/
USACE	[…] risk is the likelihood of the occurrence and the magnitude of the consequences of an adverse event. Uncertainty can be thought of as the indefiniteness of some aspect of the values in the risk quantification process. (Source: Moser, D.A. (undated), "The use of risk analysis by the US Army Corps of Engineers," Institute for Water Resources, Alexandria.
USBR	Risk is the probability of adverse consequences. It is normally calculated as the product of the probability of the load, the probability of failure (given the load), and the consequences (given that failure occurs). (Source: USBR (2009). "Best practices—Glossary," http://www.usbr.gov/ssle/damsafety/Riskel
NRCS	Risk is exposure to an undesired event. It can be expressed in probability that the event will happen, often during a calendar year. (Source: Flood Damage Assessment Tools http://www.economics.nrcs.usda.gov/technical/models/flood/

Source: Quantifying Flood Risk (Gregory B. Baecher, 2009)

Definition of Risk

Risk = f(**Probability**, Consequences)

Probability is a measure or estimation of how likely it is that something will happen or that a statement is true.

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Definition of Risk

Risk = f(**Probability**, Consequences)

- In flood risk management probability starts flow frequency (17b analysis) or precipitation modeling.
- These analysis provides - Percent chance of **exceedance** in any **single year**

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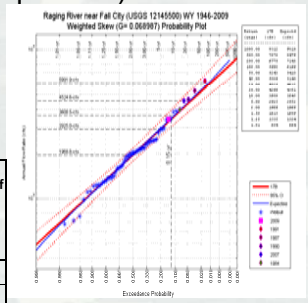
Definition of Risk

Risk = f(**Probability**, Consequences)

Event probability > Life Cycle Probability

Annual Exceed probability	Recurrence interval	Probability of Exceedance in 10 year period	Probability of Exceedance in 30 year period	Probability of Exceedance in 50 year period
%	year	%	%	%
0.2%	500	2%	6%	10%
1%	100	10%	26%	39%
2%	50	18%	45%	64%
10%	10	65%	96%	99%



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Definition of Risk

Risk = f(**Probability**, Consequences)

In flood risk we convert the flow probability into exposure probability through:

-Hydraulics: Computation of water surface elevation from flow

-Mitigation Performance: If mitigation (such as a levee) is in place its performance may prevent exposure

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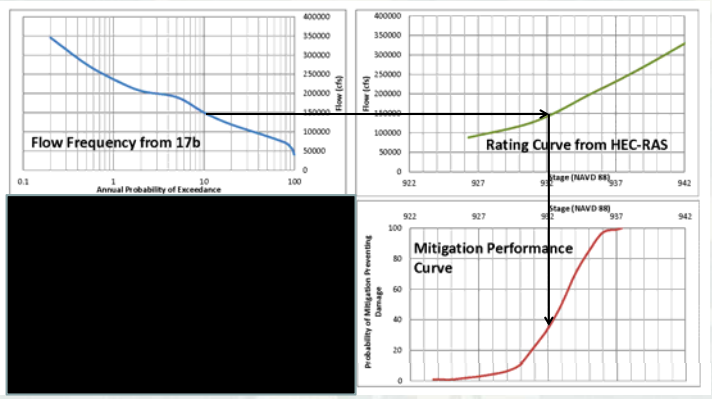
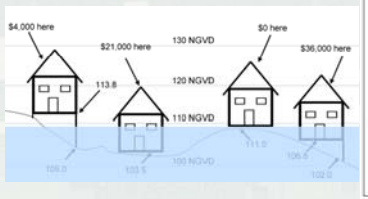
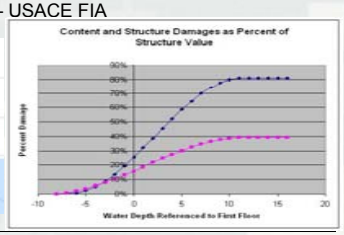


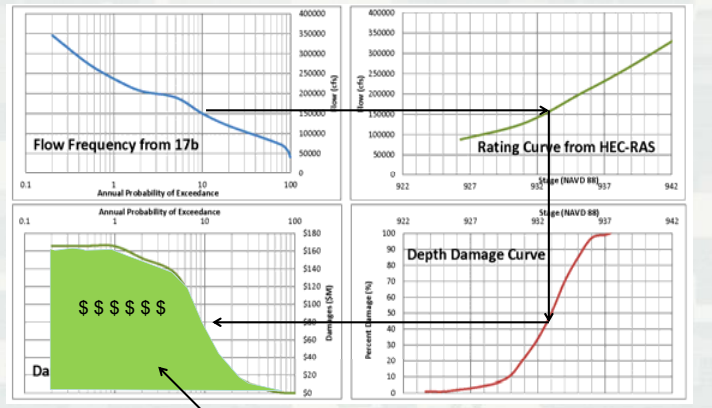
Definition of Risk

Risk = f(Probability, **Consequences**)

- **Financial**
  - National Economic Development (NED)
  - Benefit Cost Ratio >1
  - Common Financial Damage Sources:
    Buildings, Contents, Displacement, Loss of Income, Value of Service
  - Tools to compute financial damage
    FEMA BCA tool – USACE FDA – USACE FIA







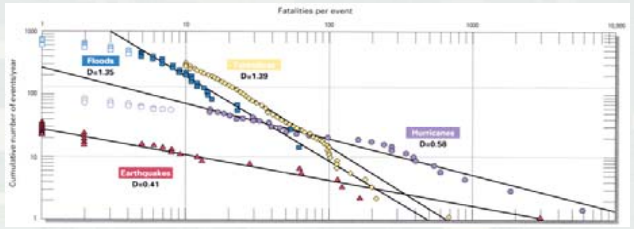
Integration of curve represents Expected Annual Damage (EAD)

Definition of Risk

Risk = f(Probability, **Consequences**)

- **Protection of Life**
  - Some analysis include with economics some don't
  - Mitigation options: Warning systems, evacuation routes
  - Tools for computation of life-loss are being developed developed (LIFESim)

Further Reading:
SN Jonkman



(Bartonand Nishenko 2000). Note, the vertical axis should be, "cumulative number of events with loss>L" not events per year.

Definition of Risk

Risk = f(Probability, **Consequences**)

•**Critical Facilities**

(concepts from Further Advice on EO11988)

- •Materials Storage - If flooded, would the this facility create an added dimension to the disaster (chemical storage)
- •Large gathering areas – would lead time/mobility permit sufficient evacuation (hospitals, schools, nursing homes)
- •Essential and irreplaceable facilities
  - •Records
  - •Utilities (water, power)
  - •Emergency services (Police, EMT, hospital, etc)

Flooded Ambulances (unknown date/location)

Definition of Risk

Risk = f(Probability, **Consequences**)

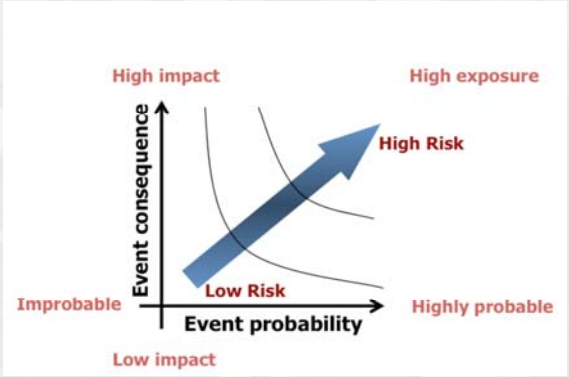
•**Personal/Sentimental Consequences**

- •Personal/Sentimental consequences vary significantly from person to person

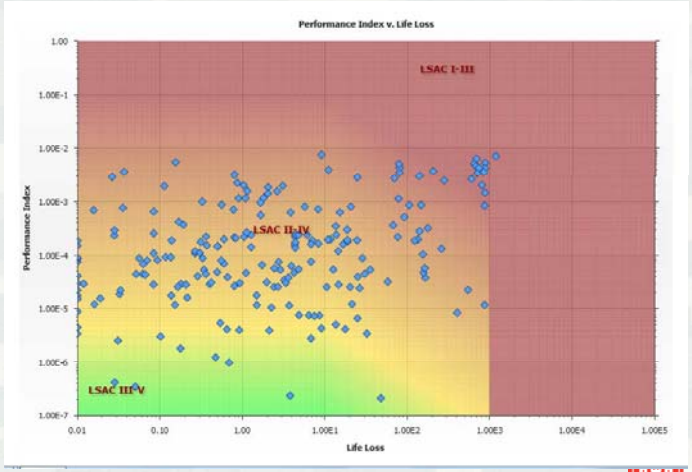
Evacuating Beer (Brisbane AU, 1981)

Stranded Dog (Seward NE, 1951)

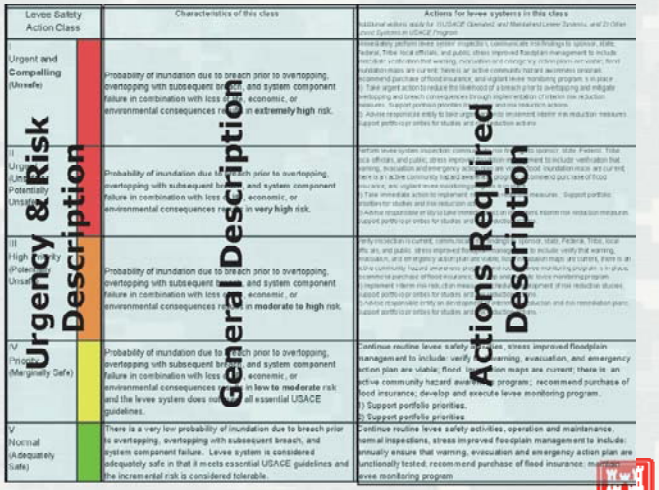
Important Papers
Family Photos
Pets
Heirlooms
Medicine
etc



Source: Quantifying Flood Risk (Gregory B. Baecher, 2009)

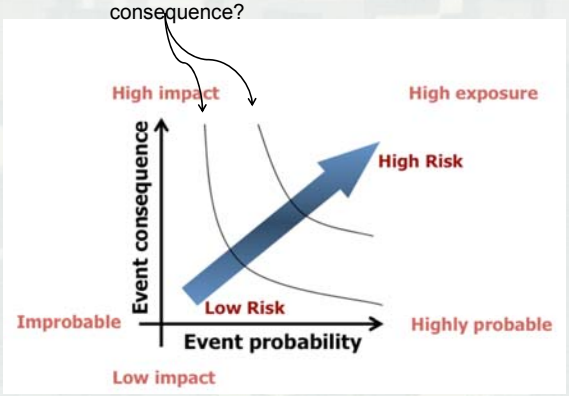


Source: Communicating Benefits and Risks Associated with Levee Systems (2012)



Source: Communicating Benefits and Risks Associated with Levee Systems (2012)

Where do these iso-lines go with very low probability or very high consequence?



Source: Quantifying Flood Risk (Gregory B. Baecher, 2009)

Risk Understanding and Risk Informed Decision Making

For High Impact Low Frequency (HILF) risk

Even if risk is "known" human judgment and decision making do **NOT FOLLOW LOGIC**

Judgment vs Decision Making

-We frequently overestimate the probability when judging generally low risk

-We frequently underestimate or negate the probability when acting on extremely low probability risk

Description vs Experience

-We are more comfortable making decisions on experience. With low frequency events we often don't have experience

- Outside of a risk management process, descriptive information is not well understood

- Prospect Theory -Kahneman, Tversky
- Gamblers Fallacy -Greg Barron
- Black Swan -Nassim Nicholas Taleb
- HILF -Gordon Graham
- Tails Event

Risk Management Process

Risk management is a process by which decision makers reduce, offset, or accept risk and subsequently make decisions that weigh overall risk against mission benefits.

Source: Defense Critical Infrastructure Program

Risk Management Process

1. identify, characterize threat
2. assess the vulnerability of critical assets to specific threats
3. determine the risk
4. identify ways to treat those risks
5. Prioritize risk reduction measures based on a strategy

(Source: ISO 31000 Risk management – principles and guidelines)

Risk Management Discussion

1. identify, characterize threat
   DRIVING
2. assess the vulnerability of critical assets to specific threats
   NA
3. determine the risk **???**
4. identify ways to treat those risks **???**
5. Prioritize risk reduction measures based on a strategy
   ???

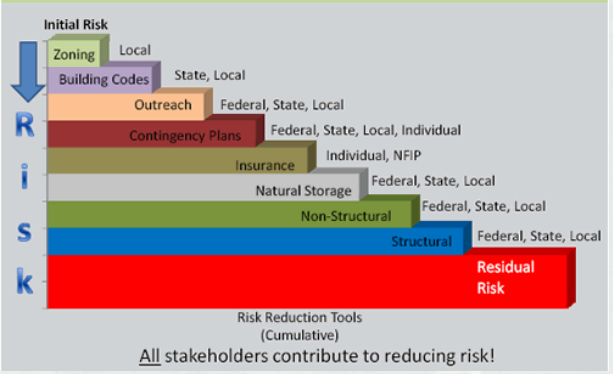
Risk Management Discussion

Table 4.2.1: Risk estimates by driver age

Age	Crash Involvement	Exposure Estimate (millions)	Absolute Risk	Relative Risk
18 years	423	103.3	4.10	3.94
19 years	610	196.7	3.10	2.98
20 years	595	183.4	3.24	3.12
21-25 yrs	2338	1307.2	1.79	1.72
26-29 yrs	1332	978.8	1.36	1.31
30-59 yrs	5241	5053.0	1.04	1.00
60+ years	858	670.2	1.28	1.23

1. identify, characterize threat
   DRIVING
2. assess the vulnerability of critical assets to specific threats **NA**
3. determine the risk **Does the above table identify risk ???**
   What are the types of consequences ???
4. identify ways to treat those risks **???**
5. Prioritize risk reduction measures based on a strategy **???**

Shared Flood Risk Management: Buying Down Risk



All stakeholders contribute to reducing risk!

Risk Treatments

- 3 types of risk treatment
  - ►Reduce – (risk reduction, risk mitigation)
  - ►Offset – (transfer, insurance)
  - ►Accept

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Risk Treatment

Risk Reduction – to modify the risk you either alter the probability or consequences

Risk = Probability x Consequences

Structural Flood Risk Reduction

Nonstructural Flood Risk Reduction

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Risk Treatment

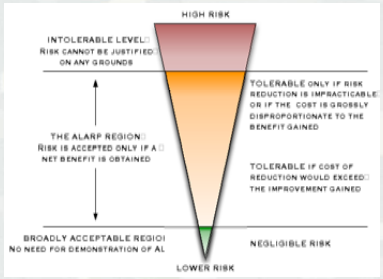
Risk Transfer

- **Insurance**: equitable transfer of the risk of a loss, from one entity to another in exchange for payment
- Actuarial rates are based on risk

NATIONAL FLOOD INSURANCE PROGRAM

Risk Treatment

- Risk Acceptance
  - ►Benefits outweigh Risk
  - ►Risk is ALARP - *as low as reasonably practicable*
  - ►Risk is shared with those receiving benefit



Tolerability of risk the HSE model (HSE 1992)

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Missouri River Levee Performance, Analysis and Repair for the 2011 Flood Event

Levee Safety Outreach
July 10, 2013

Don Moses, P.E.
Geotechnical Engineering
& Sciences Branch
Omaha District

US Army Corps of Engineers
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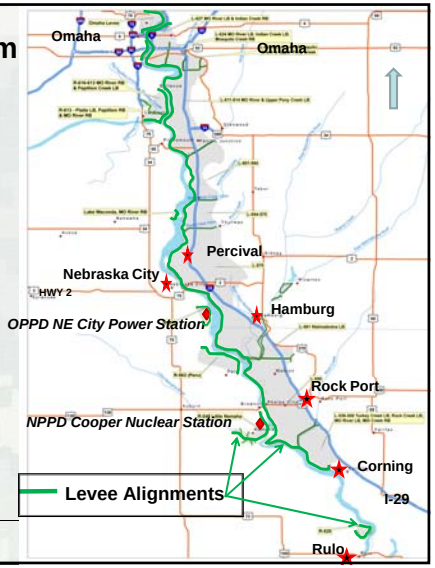
Missouri River Mainstem Levee System

- Federally Constructed, Locally Owned, Operated & Maintained Levees
- Left Descending Bank
  -Nearly Continuous from Council Bluffs, IA to near Corning, MO.
  -Approx **180 miles** of levee
- Right Descending Bank
  -Intermittent from Omaha to Rulo
  -2 Power stations
  -Approx **70 Miles** of levee



Historic Levee Failures

- **L-575 Iowa levee (Thurman to Hamburg)**
  1952 and 2011
- **L-550 Missouri levee (Rock Port)**
  1952, 1993 and 2011
- **L536 Missouri levee (South of Rock Port)**
  •1952

Historic Levee Breaches - L575 1952

Historic Levee Breaches - L575 2011 Percival (Upper)

Historic Levee Breaches - L575 2011 Hamburg (Middle)

Historic Levee Breaches - L575 1952 & 2011 Outlet Notch

Historic Levee Breaches - L550 1993 and 1952

Historic Levee Breaches - L550
1952

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L550 Outlet Breach
1952, 1993 and 2011

10 BUILDING STRONG®

Historic Levee Breaches - 1952
L550 Outlet and L536 Inlet

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Historic Levee Breaches - 1952
L536 Outlet

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MISSOURI RIVER LEVEES
CROSS SECTIONS AND FOUNDATION CONDITIONS
13
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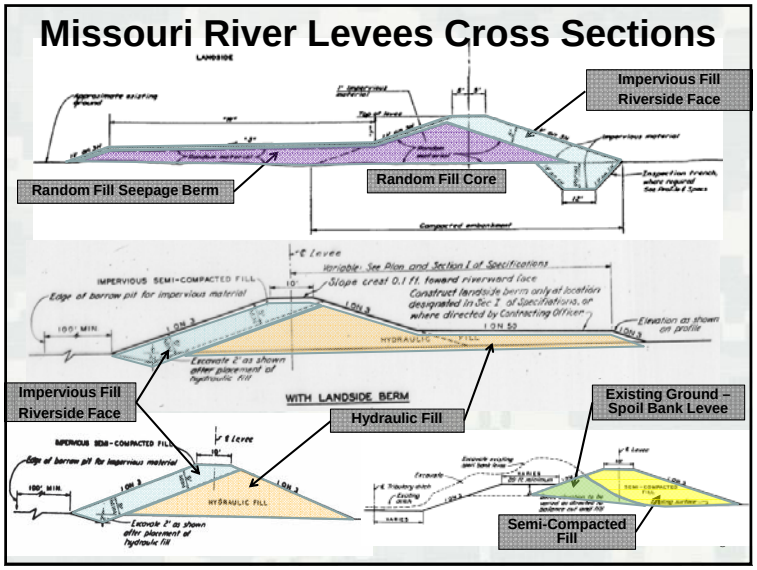
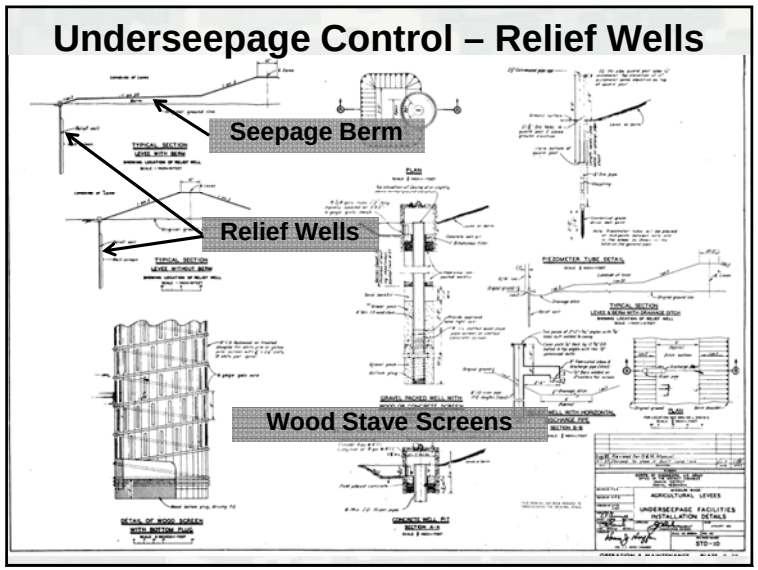
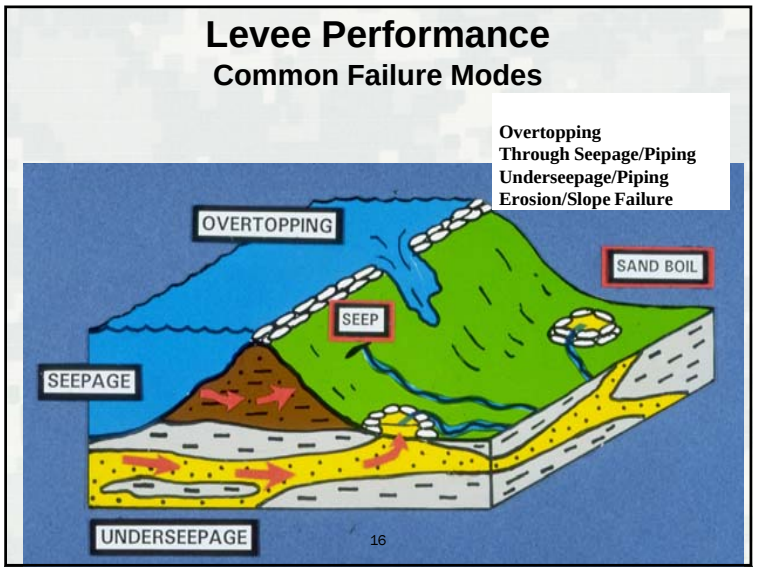

Missouri River Levees Cross Sections
Impervious Fill Riverside Face
Random Fill Seepage Berm
Random Fill Core
Impervious Fill Riverside Face
Hydraulic Fill
Existing Ground – Spoil Bank Levee
Semi-Compacted Fill


Underseepage Control – Relief Wells
Seepage Berm
Relief Wells
Wood Stave Screens


Levee Performance
Common Failure Modes
Overtopping
Through Seepage/Piping
Underseepage/Piping
Erosion/Slope Failure
OVERTOPPING
SAND BOIL
SEEP
SEEPAGE
UNDERSEEPAGE
16

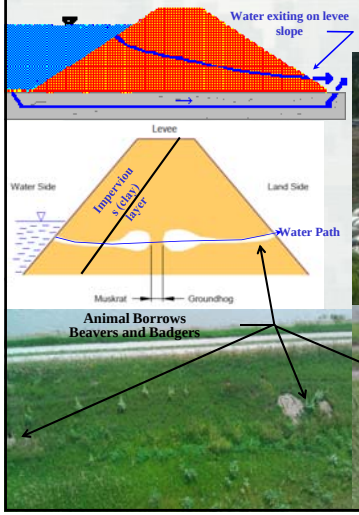
Overtopping

Photo:
June 21, 2011
Levee Unit L550 overtopping, just upstream of HWY 136

L-536 Overtopping at Access Ramp (July 1, 2011)

- Low spots created by traffic
  Common to all levees
- Low spots created by levee foundation settlement
  (L-601)
- Sand levee can not resist overtopping
- Clay levees can resist overtopping for longer times

Through Seepage/Piping



Landside Slope, Sandbag Seepage/Stability berm under construction due to through seepage related concerns

Erosion - Many Causes – Significant Impacts

- Adjacent levee failures
- Natural and Manmade Excavations
- Riverside ramps
- Riverside fences
- Levee Alignment
- Floodplain Geometry
- Trees

Corning and L536 (June 11, 2011)

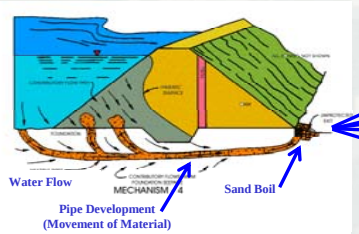
L536 Corning Levee (June 24, 2011)

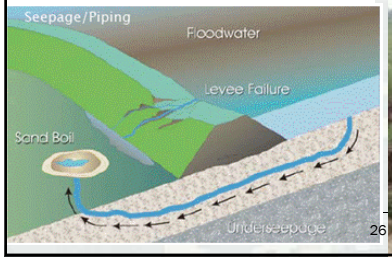
L-536 Erosion Repair

L-536 1993 and 2011 Erosion Repairs

L-536 Borrow Area Reclaimed as Wetland Mitigation

Underseepage/Piping





Levee Unit L575 near Hamburg, IA 4 June 2011
Looking towards levee crest from landside berm

L575
Levee Assessments and Repairs

- Located on the Missouri River East (left) bank
- Traverses through three states with 5 different sponsors
- Over 30 miles long
- Two breaches and one outlet notch
- Sustained major damage
- Five levee setbacks (totally nearly 12 miles in length)

What Caused the Levee Failures?

- The levee was approximately 12 feet high
- The levee had 5-6 feet of freeboard
- The levee had a landside seepage berm
- The levee had landside relief wells

Contributing Factors Riverside Scour

- Geomorphology
- River and Floodplain Geometry
- Levee Alignment
- Manmade Impacts

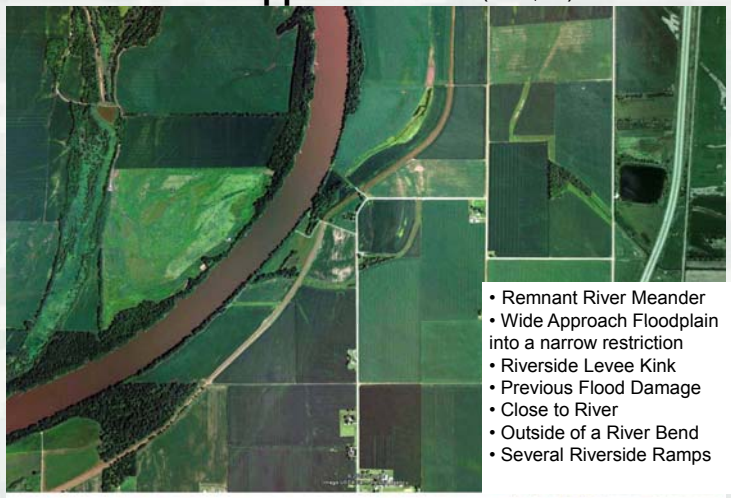
Floodplain Geometry and Geomorphology

- Wide flood plain funneling to narrow flow passages
- Remnant River Meanders
- Proximity to the River
- Cutting across inside of bends
- Outside of river bends
- Historic Borrow Pits
- Flow Restrictions

Levee Alignment

- Riverward Alignment Kinks
- Riverside Ramps

L575 Upper Breach (June 21, 2009)



- Remnant River Meander
- Wide Approach Floodplain into a narrow restriction
- Riverside Levee Kink
- Previous Flood Damage
- Close to River
- Outside of a River Bend
- Several Riverside Ramps

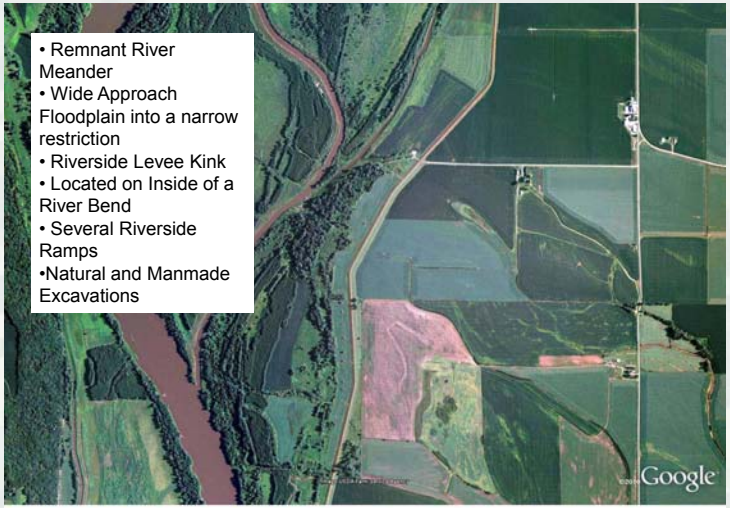
L575 Upper Breach (June 11, 2011)

L575 Upper Breach (Aug 11, 2011)

L575 Upper Breach

L575 Upper Breach (Sept 9, 2012)

L575 Middle Breach (Aug 11, 2009)



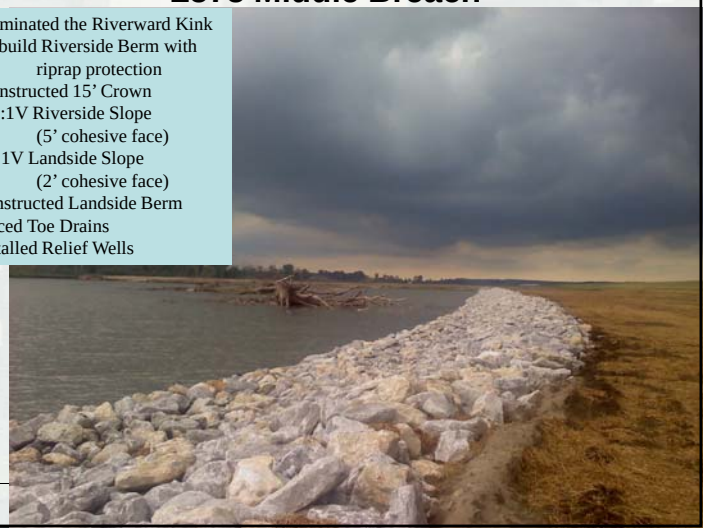
L575 Middle Breach (July 17, 2011)

L575 Middle Breach (July 17, 2011)

L575 Middle Breach (Sept 14, 2012)

L575 Middle Breach

- Eliminated the Riverward Kink
- Rebuild Riverside Berm with riprap protection
- Constructed 15' Crown
- 3H:1V Riverside Slope (5' cohesive face)
- 5H:1V Landside Slope (2' cohesive face)
- Constructed Landside Berm
- Placed Toe Drains
- Installed Relief Wells



Highway 2 – Remnant River Meanders

(June 21, 2009)

Highway 2 – Flow Restriction (June 17, 2011)

Segment 4, June 15

Highway 2 – 3 Mile Setback

Highway 2 – 3 Mile Setback

Highway 2 – 3 Mile Setback

Riverside Ramps Causing Erosion and Landside Sandboils

Riverside Ramps Causing Erosion and Landside Sandboils

Highway 2 – Remnant River Meanders

(Sept 22, 2011)

Highway 2 – 3 Mile Setback

(Sept 21, 2012)

Highway 2 – South One Mile Setback

(June 13, 2013)

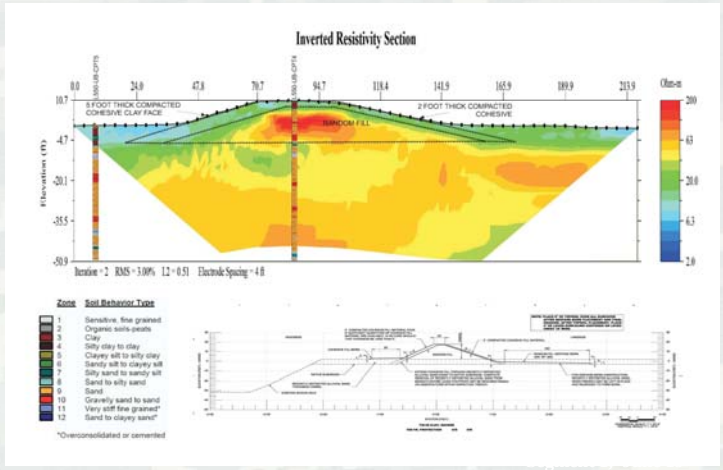
Highway 2 – North Three Mile Setback

(June 13, 2013)

Design Methods and Tools

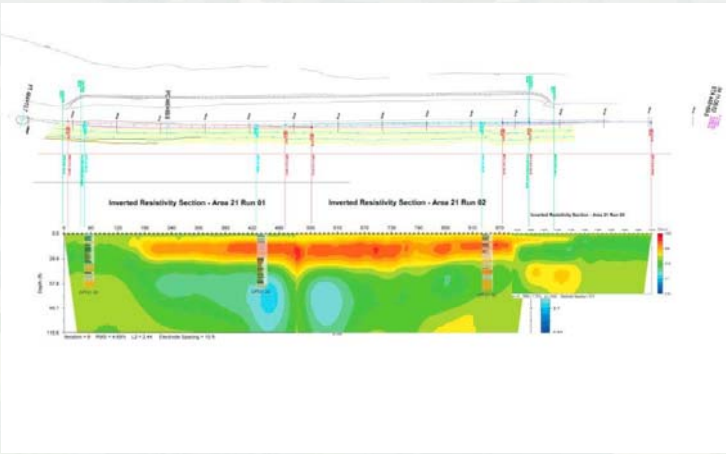
- Corporate Knowledge of Previous Breach Repairs
- MICA Points – Flood surveillance -Google Earth
- GPS Surveying Technology
- MERs (Multi-electrode Resistivity) Geophysics
- CPTs (Cone Penetrometer)
- Trenching
- Traditional Borings, Sampling and Testing
- GeoStudio (SEEP/W)

Upper L550 – New Embankment MER CPT Correlation



L550 Outlet Breach 1952, 1993 and 2011

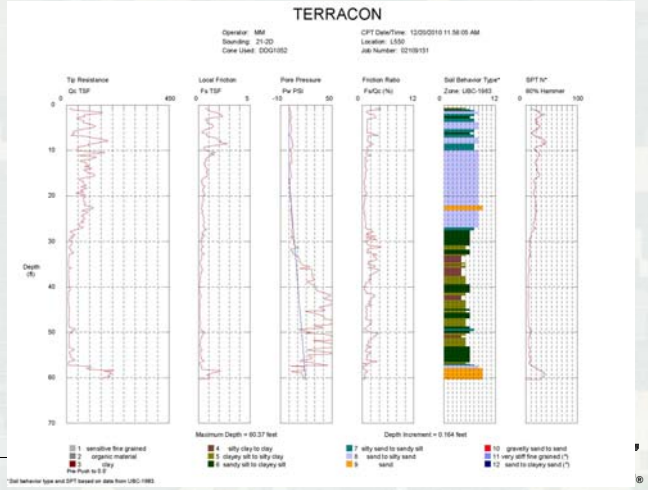
1952 L550 Outlet Breach (2010)



Cone Penetrometer

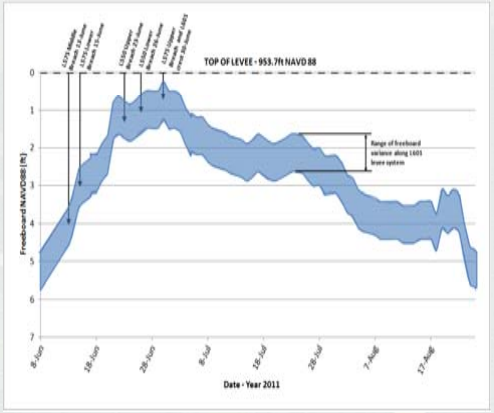
- Direct Push Technology
  - Tip Resistance
  - Sleeve Fiction
  - Pore Pressure
- Defines sub-surface stratigraphy
- Identifies soil types
- Locates water table
- Geotechnical parameters
  - Strength
  - Permeability

1952 L550 Outlet Breach (2010)



L-601 June 11, 2011 (Bartlett, IA)

L-601 Missouri River Elevations



Mobile Information Collection Application – Flood surveillance

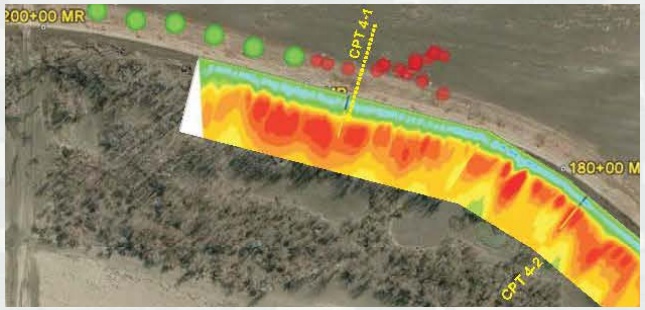
GPS Cell Phone – Flood surveillance

Post Flood – Walking the Levee

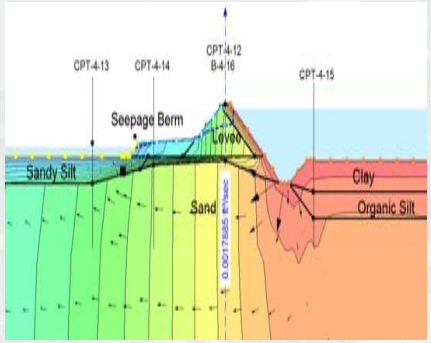
Phase I Construction

Phase 2 MER, CPT and Boring Data

Phase 2 MER, CPT and Boring Data



SeepW Modeling



Phase 2 Construction –Added Relief Wells

L575 Sta 11+85 Setback

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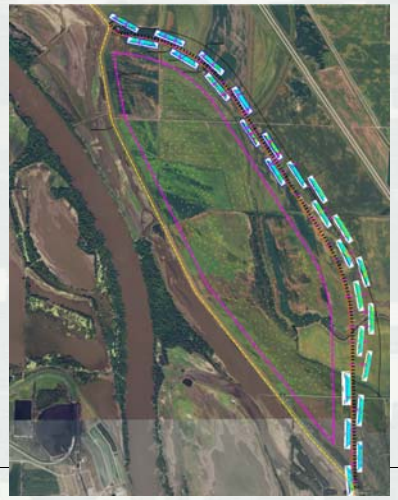
L575 Sta 11+85 Setback



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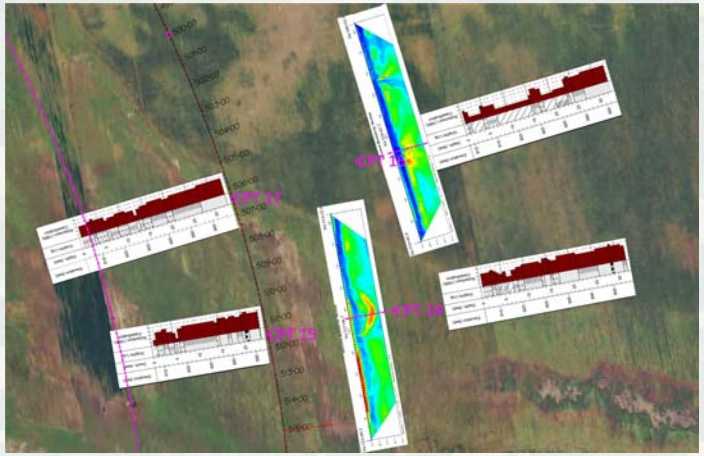

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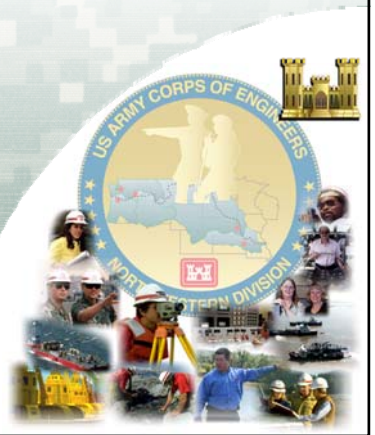
L575 Sta 11+85 Setback - Completed

Conclusion – Advantages of the Levee Setbacks

- Minimizes the wide flood plain funneling to narrow flow passages
- Locates the levee off of the Remnant River Meanders
- Locates the levee away from the River
- Levee is located on higher ground
- The flood water surface profile is reduced
- The levee is relocated off of damaged foundations

Levee Safety Program

Bryan P. Flere, P.E.
Levee Safety Program Manager
United States Army Corps of Engineers
Omaha District
July - 2013



US Army Corps of Engineers
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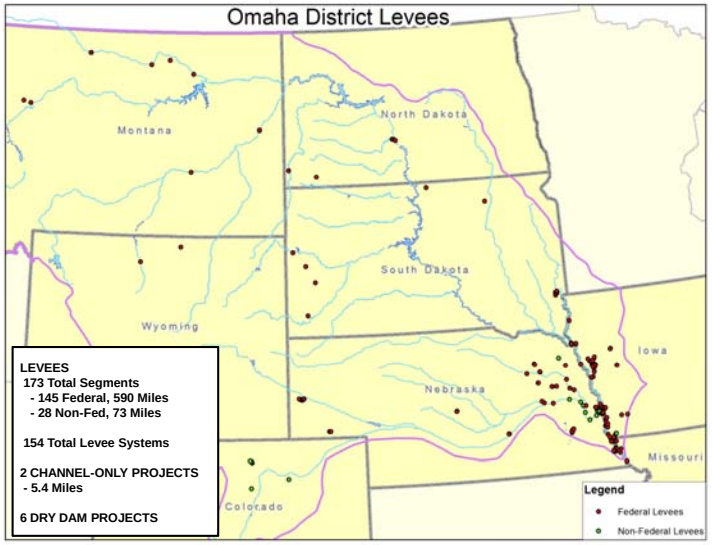
Agenda

- Overview of Levee Safety Program
- National Levee Database (NLD)
- USACE Levee Inspection Process (CEI)
- Periodic Inspections (PI)
- System Wide Improvement Framework (SWIF)
- Section 408 Modifications
- Levee Screening
- Vertical Datum

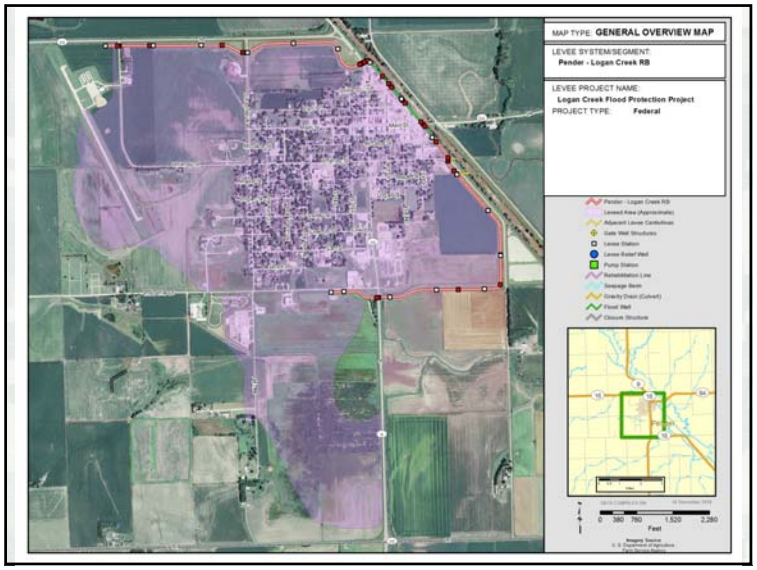


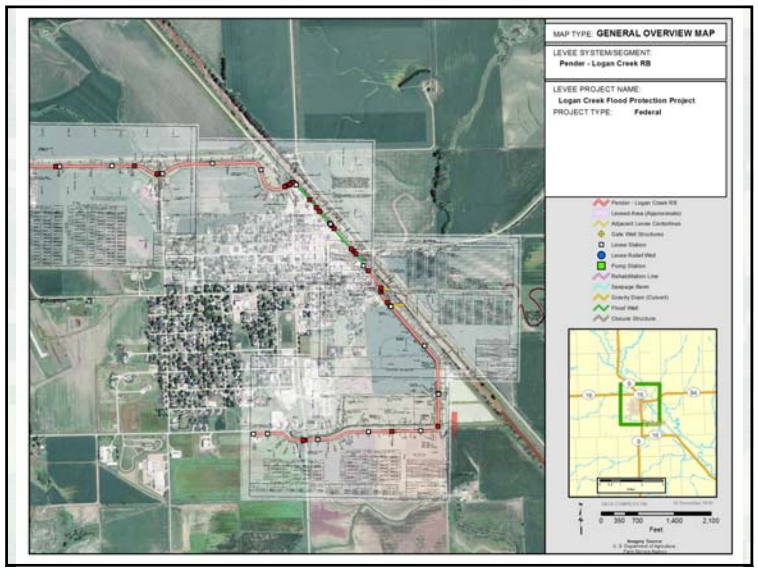
Levee Safety Program

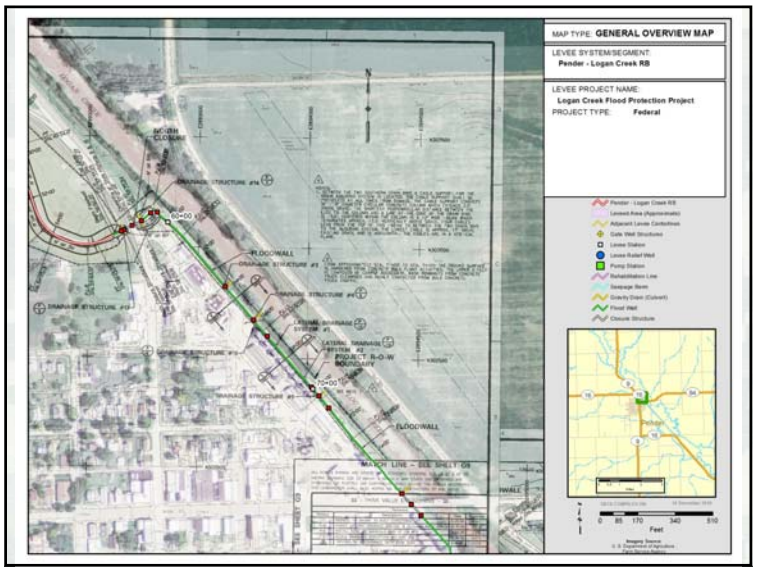
- Levee Safety Program Implementation Guidance provided by HQUSACE in 2007
  - Designate Levee Safety Officer
  - Designate Levee Safety Program Manager
  - Implement Levee Inspection Tool and Levee Inspection Checklist
  - Create District National Levee Data Base
- Subsequent Levee Safety Guidance
  - System Wide Improvement Framework (2011)
  - Section 408 Modifications (2008, 33 USC 408 replaces 33 CFR 208.10)
  - Levee Screening Assessments (2009)
  - Vertical Datum (2006)

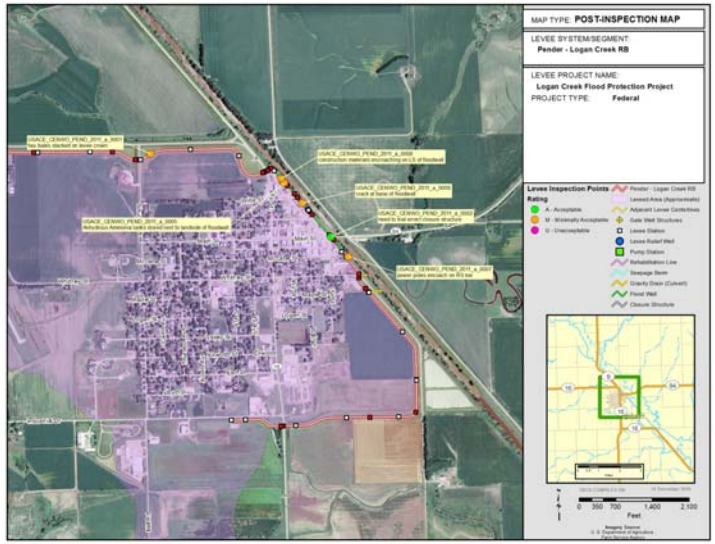
National Levee Database (NLD)

- GIS-centered database that houses USACE Levee Information
  - Geospatial Data – Levee Inventory (2010)
  - Continuing Eligibility Inspection Reports – Annual Inspections
  - Periodic Inspections – 5 year intervals
  - Levee Screenings
  - Vertical Datum Data
- Vast amounts of Information uploaded in NLD
  - External Website for Public Access Detailing Overall Levee System Rating: http://nld.usace.army.mil









Inspection Program - Purpose

- Projects in the Public Law (PL) 84-99 Rehabilitation and Inspection Program (RIP) get an Continuing Eligibility Inspection (CEI).
- The primary purposes of the CEIs are to prevent loss of life and catastrophic damages; preserve the value of the Federal investment; and to encourage non-Federal sponsors to bear responsibility for their own protection.
- This program should assure sponsor compliance with existing agreements that the structures and facilities constructed by the United States for flood protection will be continuously maintained.

USACE Levee Inspection Process

- Federal Projects – Inspected every (1) year
- Non-Federal Projects – Inspected every two (2) years
- Inspected by:
  - Operations Project Office Personnel (typically an Engineer Technician)
  - Levee Safety Engineer (LSE)
- Inspection Checklist
  - Utilized for Continuing Eligibility Inspections
  - Annual Inspection Report Sections include Levee Embankment, Concrete Floodwalls, Sheet Pile and Concrete I-Walls, Interior Drainage Structures, Pumps Stations, and Flood Damage Reduction Channels
  - Overall Inspection Rating of Acceptable and Minimally Acceptable, Project Active Status in PL 84-99
  - Overall Inspection Rating of Unacceptable, Project Inactive

Periodic Inspection (PI) Initiative

- Executed at 5 year intervals for federal levees per guidance
  - Periodic Inspections are more comprehensive and rigorous than Continuing Eligibility Inspections
  - Periodic Inspection are have a Professional Engineer as Lead
  - Inspection team is multi-disciplined including Geotechnical, Hydrological, Structural, Mechanical and Electrical Engineers
  - Inspection Report includes design criteria comparisons between current USACE criteria to the criteria the project was designed within the past
  - Inspection Checklist utilized for Overall Project Rating

System Wide Improvement Framework

- Policy for Development and Implementation of System-Wide Improvement, dated 29 Nov 2011, signed by HQ.
- Projects with an overall unacceptable rating go “inactive” in the RIP and ineligible for rehab assistance.
- The System Wide Improvement Framework (SWIF), is a process for which projects can stay temporarily active within PL 84-99, while the sponsor plans and works to correct the identified deficiencies.
- A SWIF provides committed sponsors the opportunity to restore their levees, over time, back to USACE standards.

Section 408 Modification

- Levee Project modifications/alterations are accomplished with Minor/Major Modification Reviews
  - Minor Section 408 modification reviews are for “relatively minor, low impact alterations/modifications related to operations and maintenance responsibilities of the non-Federal sponsor”
  - Major Section 408 modification reviews are for “include degradations, raisings, and realignments and other alterations/modifications” not considered a Minor Section 408 modification.
- Section 408 and FEMA Certification Relationship
  - Non-Federal sponsors modifying Federal Levees to attain FEMA Accreditation for the National Flood Insurance Program (NFIP) may require USACE Major Section 408 Approval.

Levee Screening Initiative

- Risk Based Approach to Quantify and Manage Risk
  - Levee Screening Supports the following principals
    - Life Safety is Paramount
    - Flood risk reduction infrastructure reduces risk; it does not eliminate risk
    - Living with flood risk reduction infrastructure is a share responsibility
    - Take appropriate actions to reduce risk
    - Flood risk is dynamic and changes over time
  - Levee Screening Tool Determines Levee Safety Action Classification (LSAC)
    - Prepared by a multidisciplinary team within NWO
    - Utilizes existing Annual and Periodic Reports
    - Prior levee system flood performance
    - Modeled after the Dam Safety Classification Methodology

Levee Screening Initiative

- Levee Safety Action Classification (LSAC)
  - LSAC Class I - Urgent and Compelling
  - LSAC Class II - Urgent
  - LSAC Class III - High Priority
  - LSAC Class IV - Priority
  - LSAC Class V - Normal

Vertical Datum Initiative

- NWO Levee Status on Vertical Datum Initiative
  - 2006 – Policy Guidance Memorandum - Completed
    - Inventory Vertical Datum on all flood damage reduction project
    - Identify Deficiencies that require correction
    - Transition to correct Datum
    - Implement appropriate project changes

Levees and the National Flood Insurance Program

Shandi Teltschik, P.E., CFM
Natural Hazards Program Specialist
FEMA Region VII

FEMA

Floods are the #1 natural disaster in the United States.

Everyone lives in a flood zone.

New land development can increase flood risk.

In 2007, flooding occurred in all 50 states.

Homeowners insurance typically does not cover flood damage.

National Flood Insurance Program (NFIP)

- National Flood Insurance Act of 1968
- Flood Disaster Protection Act of 1973
- National Flood Insurance Reform Act of 1994; Flood Insurance Reform Act of 2004
- Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12)

Goals of the NFIP

- Reduce loss of life, property, and cultural resources caused by flooding;
- Reduce rising disaster relief costs caused by flooding, and;
- Require owners of structures in high flood risk areas with federally-backed mortgages to carry flood insurance.

Reaching Those Goals...

- **Floodplain Mapping**
  - **I.D. risk**
- **Floodplain Management**
  - **Risk Reduction**
- **Flood Insurance**
  - **Transfer risk**

Floodplain Mapping

- **Establishes the Special Flood Hazard Area (SFHA)**
  - **Flood Hazard Boundary Map (FHBM)**
  - **Flood Insurance Rate Map (FIRM)**
  - **Flood Insurance Study (FIS)**
- **Used as the basis for regulating new development**
- **Used by insurance agents when rating flood insurance policies.**
- **Used by Lenders and Federal agencies to determine when flood insurance must be purchased as a condition of a loan or financial assistance.**

Floodplain Management

Overall community program of corrective and preventative measures for reducing future flood damage

- **Guide future development away from high flood risk areas**
- **Flood damage prevention ordinance**
  - 44 CFR 60.3
  - Minimum Federal Requirements

Flood Insurance

- **Available in communities that participate in the NFIP – underwritten by the federal government**
- **Required for structures in SFHAs that have federally insured mortgages**
- **Flood is NOT covered under most homeowners policies.**
- **Available for every building located in a participating community**
- **Coverage**
  - Building, Contents, or Both

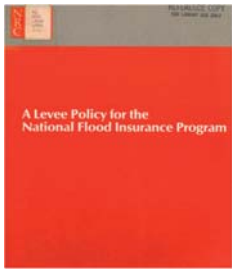
Flood Insurance Price – what affects it?

- **Flood risk zone of structure – SFHA vs. low risk area**
- **Elevation of lowest floor**
- **Construction date of the structure**
- **Type of structure**
- **Flood loss history of the structure**
- **BW-12**

NATIONAL FLOOD INSURANCE PROGRAM

Levees and the NFIP – history…

- **Flood Control Acts of 1917, 1928, and 1936**
- **1968 – NFIP Enacted**
- **1973/1974 – Flood Control Disaster Act and Brooks Amendment**
- **1982 – A Levee Policy for the NFIP published**
- **1986 – 44 CFR 65.10**



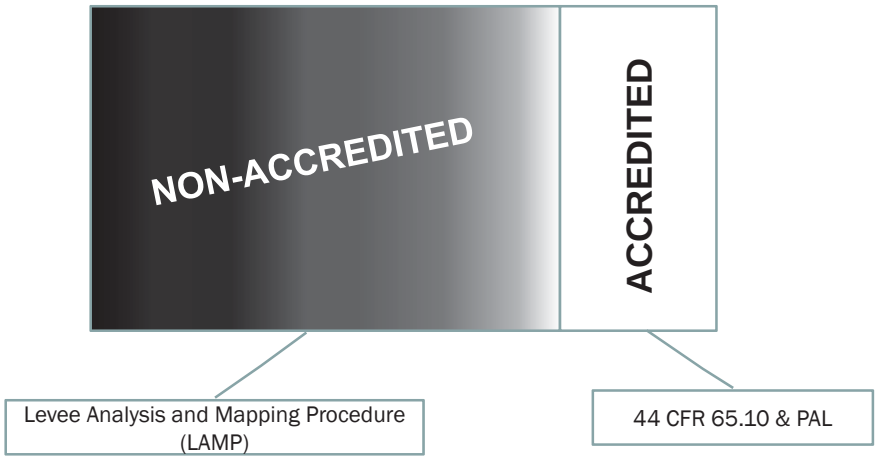
*History of Levees Fact Sheet
*NFIP and Levees – Fact Sheet, FAQ
*Facts About Levees Info Sheet

Levees and the NFIP – history, cont'd.

- **2004 – FEMA's Flood Map Modernization Program**
- **2006 – Interagency Levee Policy Review Committee**
  - National Levee Challenge: Levees and the FEMA Map Modernization Initiative
- **Procedural Memorandums on mapping levees on FIRMs**
  - 2005 – PM 34: Interim Guidance on Studying Levees
  - 2007 – PM 43: Guidelines for identifying Provisionally Accredited Levees
- **2011 - Senator Cochran letter to FEMA Administrator Fugate**
  - Request for FEMA to examine its methodology for non-accredited levees
  - Draft Revised Analysis and Mapping Procedures for Non-Accredited Levees: Proposed Approach for Public Review

*PM Fact Sheet
*PAL Fact Sheet - Q&A for PM 43

Levees and the NFIP – present…



*Certification vs. Accreditation Info Sheet
*Levee Mapping Complying with 65.10

LAMP

- **Proposed approach for NON-ACCREDITED levees to be shown on Flood Insurance Rate Maps**
- **5 potential methodologies**
  - Sound Reach
  - Freeboard Deficiency
  - Overtopping
  - Structural-based Inundation
  - Natural Valley

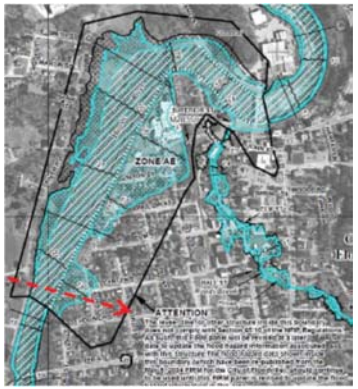
*Narrated public webinar at FEMA's levee website

LAMP

- **Mapping projects with non-accredited levees (including expired PALs) are on hold**
- **LAMP guidelines currently being vetted through FEMA HQ and eventual to Congress this summer**
- **Implementation of LAMP procedures subject to final approval and (in FY 13) restricted to a limited number of Pilot**
- **Levee Evaluation Report on FEMA/USACE interaction on levees**
  - Review by Congress before implementation

Seclusion Method

- **New method to move FEMA mapping forward mapping projects that were placed on hold due to LAMP**



*Seclusion Method Info Sheet

Summary

- **NFIP enacted to provide flood insurance for communities in exchange for their adoption of floodplain management standards**
- **FEMA is responsible for identifying high risk flood areas for implementation of floodplain management criteria and flood insurance**
- **Accredited levees versus non-accredited levees – mapping for the NFIP**
  - Levee Analysis and Mapping Procedures
  - Seclusion Method

Resources

- **FEMA's Levee Website:**
  http://www.fema.gov/living-levees-its-shared-responsibility

- **FEMA Region VII Contacts:**

  Levee Outreach
  Dawn Livingston
  (816) 283-7055
  Dawn.Livingston@fema.dhs.gov

Levee Certification thru USACE

Randall L. Behm P.E., CFM
Chief, flood risk and floodplain Management Section
Chair, Nonstructural Flood Proofing Committee

July 10, 2013

US Army Corps of Engineers
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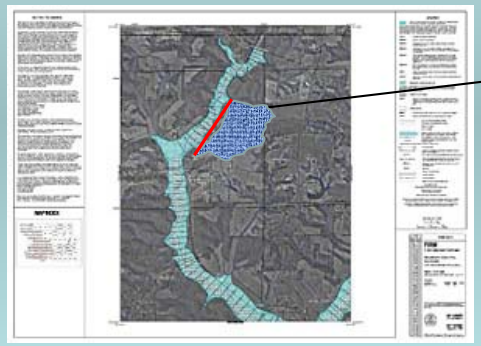
So you received a letter (PAL) from FEMA requesting you to recertify your existing federal levee because the floodplain maps are to be updated, now what……



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What Actions Can You Take…..

1. **Contact the Corps, they'll take over the certification process**
   - No can do. Current policy prevents Corps from recertifying existing levees

2. **Contact your congressman. He'll force the Corps to recertify the levee**
   - It's been tried many times, to no avail

3. **Hire an Engineering Firm <u>familiar</u> with the NFIP to recertify our levee.**
   - **That's the answer.** But for the sake of your community beware that…

   a) You should not recertify your levee using old data (paper to paper cert)
   b) Conditions to which your levee was designed may have changed (hydrology, river stages, infrastructure, channel capacity)
   c) Modification to your levee could result in a whole new set of requirements to meet USACE PL84-99 (33 USC 408) criteria.

BUILDING STRONG®

So you are partnering with USACE on construction of a levee and want to ensure that the levee will be accredited by FEMA now what……

USACE Levee Evaluation Procedures

- **EC 1110-2-6067 (Process for NFIP Levee System Evaluation)**
- **Active USACE Projects (Design and/or Construction)**
- **Does Not Certify Performance**
- **Does Certify Data, Analysis, Structural Works, "As-Built" Conditions**
- **Requires Agency Technical Review**
- **Levee Safety Officer is Approving Official (negative or positive report)**
- **10-Year USACE Time Stamp on Evaluation**

BUILDING STRONG®

Flood Risk Reduction through Probability/Performance Alteration- Structural Alternatives

Colleen Horihan, P.E, CFM

Hydraulic Engineer
Omaha District
July 10, 2013

US Army Corps of Engineers
BUILDING STRONG®

Definition of Risk

- **Risk** is the likelihood of occurrence and magnitude of consequences

Risk = f(Probability, Consequences)

- Structural treatments attempt to reduce the **probability** of flooding in an area.

Structural vs. Nonstructural Alternatives

- **Structural:** Measures such as levees, reservoirs and channel modifications tend to change the characteristics of flooding, by altering the frequency of flooding.
- **Nonstructural:** Measures such as elevation, relocation, and flood proofing adapt to the natural floodplain without changing flood characteristics.

Structural Alternatives

- Levees
- Floodwalls
- Dams
- Channels

Possible Positive Effects of Levee Construction

- Flood risk reduction on landward side of levee
- May increase economic benefits to landward structures and land
- May reduce or eliminate flood insurance

Possible Negative Effects of Levee Construction

- May have adverse impact on water surface elevations and velocities
- Requires real estate
- May require a solution to interior drainage issues
- Disconnects the historic floodplain and river
- Requires annual funding for Operation, Maintenance, Repair, Replacement, and Rehabilitation
- Potential for failure if loaded, e.g. overtopping, breach
- Level of Protection could decrease with time as basin evolves

Section 408 Modification

- Levee Project modifications/alterations are accomplished with Minor or Major Modification Reviews by USACE
- **Minor** Section 408 Reviews
  - Minor Section 408 modification reviews are for "relatively minor, low impact alterations/modifications related to operations and maintenance responsibilities of the non-Federal sponsor"
  - If proposed changes are limited to restoring the authorized level of protection or improving the structural integrity of the protection system and do not change the authorized structural geometry or hydraulic capacity they may be considered minor modifications
  - Reviewed and approved at the District level
  - Examples: Pump houses, stairs, pipes, bile trails, sidewalks

Minor Section 408 Review Requirements

- **Minor** Section 408:
  - The critical area (where any construction activity is taking place) is generally 300 feet riverward and 500 feet landward from the levee centerline
  - Submittals must be coordinated and processed through the sponsor of the Flood Risk Reduction Project (FRRP)
  - The Engineer of Record (EOR) for the proposed modification must demonstrate and state that the proposed modification does not adversely affect the operation or integrity of the FRRP
  - Submittal package shall include this certification and be signed and sealed by EOR
  - Generally three complete printed sets and one complete digital PDF of all documents should be provided
  - USACE reviews generally take 6-8 weeks

Minor Section 408 Review Requirements

- **Minor** Section 408:
  - Submittal should include cover page, technical assessment, O&M manual information, design information, drawings, specifications, and any supporting data
  - O&M addendum required for those features that are located within the project area
  - USACE reviews generally take 6-8 weeks
- http://www.nwo.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/2034/Article/3778/minor-section-408-modification-guidance.aspx

Section 408 Modification

- **Major** Section 408 Reviews
  - Major Section 408 modification reviews are for "degradations, raisings, and realignments and other alterations/modifications" not considered a Minor Section 408 modification
  - If engineering analysis indicates that the system performance is adversely impacted by the alteration/modification, then the proposed alteration/modification must be submitted for approval by the Chief of Engineers
  - System performance includes the portions of the watershed above and below the proposed site of alterations/modifications to the extent that adverse impacts can be identified
  - Adverse impacts include any significant increase in risk to public safety
  - Reviewed by District, Division, and HQUSACE. Approved by Chief of Engineers
  - Examples: non-federal levee tie-ins, ramps, riverside landscaping, fill against levee, bridges, seepage berms

Major Section 408 Modifications

- **Major** Section 408 Review Requirements
  - The critical area (where any construction activity is taking place) is generally 300 feet riverward and 500 feet landward from the levee centerline
  - Submittals must be coordinated and processed through the sponsor of the Flood Risk Reduction Project (FRRP)
  - The Engineer of Record (EOR) for the proposed modification must demonstrate and state that the proposed modification does not adversely affect the operation or integrity of the FRRP
  - Submittal package shall include this certification and be signed and sealed by EOR
  - Generally eight complete printed sets and one complete digital PDF of all documents should be provided
  - Reviews generally are completed for the 60%, 90% and 100% design. This review process has taken up to 2 years for completion.

Major Section 408 Modifications

- **Major** Section 408 Review Requirements
  - ***Policy and Procedural Guidance for the Approval of Modification and Alteration of Corps of Engineers Projects-October 23, 2006***
  - ***Clarification Guidance on the Policy and Procedural Guidance for the Approval of Modifications and Alterations of Corps of Engineers Projects-November 17, 2008***
    - ***Geotechnical, structural, hydraulic, and hydrologic evaluations***
    - ***Operation and Maintenance requirements***
    - ***Public interest determination***
    - ***Real estate analysis***
    - ***Residual risk analyzed with HEC-FDA model***
    - ***Executive Order 11988 considerations discussed***
    - ***Environmental Protection compliance***

Section 408 Modification

- USACE Major Section 408 and FEMA Accreditation Relationship
  - Non-Federal sponsors modifying Federal Levees to attain FEMA Accreditation for the National Flood Insurance Program (NFIP) may require USACE Section 408 Approval
- Omaha District has completed 3 Major Section 408 Reviews
  - Waterloo (NE)
  - I-80 Council Bluffs (IA)
  - Hooper (NE)
- 2 Major Section 408 Modifications are currently in Review
  - Columbus (NE)
  - Missouri River Levee R613-R616 (NE)

Flood Risk Reduction thru Nonstructural Alternatives

Randall L. Behm P.E., CFM
Chief, flood risk and floodplain Management Section
Chair, Nonstructural Flood Proofing Committee

July 10, 2013

US Army Corps of Engineers
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Tools for the Toolbox

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Nonstructural: Measures such as elevation, relocation, and flood proofing adapt to the natural floodplain without changing flood characteristics.

Structural: Measures such as levees, reservoirs and channel modifications tend to change the characteristics of flooding, by altering the frequency of flooding

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Nonstructural and Floodplain Management Measures

- **Elevation**
- **Relocation**
- **Buyout/Acquisition**
- **Wet Flood Proofing**
- **Dry Flood Proofing**
- **Ring Levees/Floodwalls**
- **Flooding Warning System**
- **Emergency Preparedness/Evacuation Plans**
- **National Flood Insurance Program (NFIP)**

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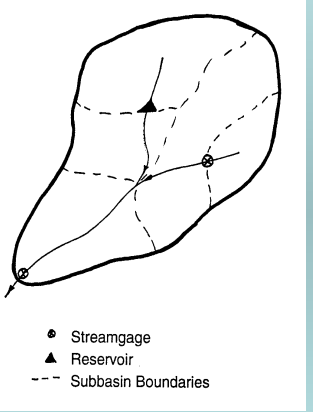
National Objective

Maximize Net National Economic Development (NED) Benefits

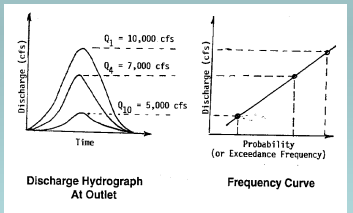
The basis for damage reduction benefits is the comparison of the Without-Project Condition (expected future condition) against the With-Project Condition (project in place) over a period of analysis (50 years by regulation).

Hydrologic Studies

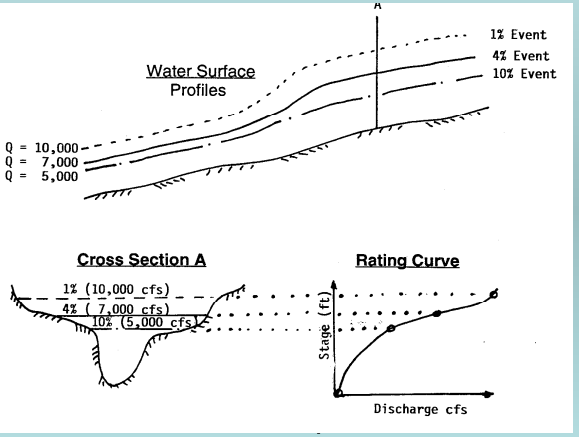


Sub-basin Delineations

- Stream Topology
- Streamgage Locations
- Project Locations

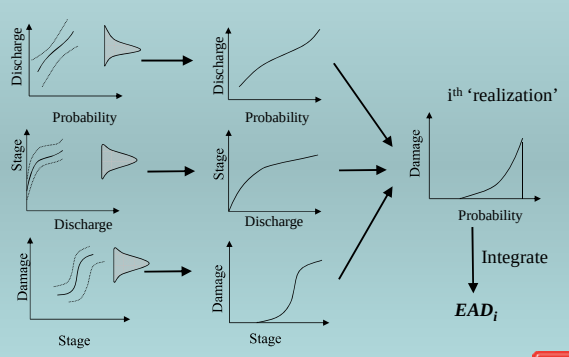


Hydraulic Studies

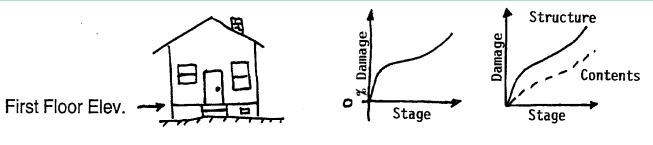


Flow-Frequency; Stage-Discharge; Damage-Frequency Relationships

(used in both nonstructural and structural assessments)



Nonstructural Building Inventory Data



- Structure ID
- Location/Address
- Structure Value
- Content Ratio
- Damage Category
- Depth-Damage Function
- First Floor Elevation
- Lowest Adjacent Ground Elevation
- Coordinates (location by xyz)
- Stream Station (river mile)

Structure Types: one story, two story, split entry, tri level slab, crawl space, basement

Construction Material: wood, brick, steel frame, masonry, concrete, stucco, pebble Dash

Elevation on Fill



Elevation on Piers, Posts, Piles, or Columns




Elevation on Piers, Posts, Piles, or Columns




Example Elevation on Extended Foundation

- Site Inspection
- Obstruction removal
- Preparation for steel placement
- Steel placement
- Shimming floor joist
- Unified lift system
- Raise in place
- Constructing new foundation
- Lowering on new foundation
- Steel removal
- Decks and landings
- Final touches

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Obstruction Removal

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Raising The Structure

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Constructing New Foundation

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Final Touches

(before)

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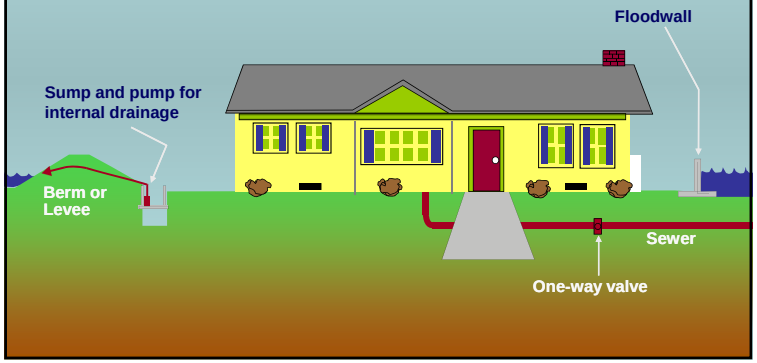
Berms, Ring Levees and Floodwalls



Earthen Berms/ Ring Levees

Not for FEMA levee accreditation

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Floodwall

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Acquisition

- Acquire the land and structures
- Demolish structures or sell and remove

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Floodplain Evacuation via Relocation / Acquisition

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Relocation

"Remove the Structure from the Floodplain"

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Relocation Works

(brick, wood, historic, contemporary, multi-story)

STRONG®

Darlington, WI Historic Commercial Flood Proofing

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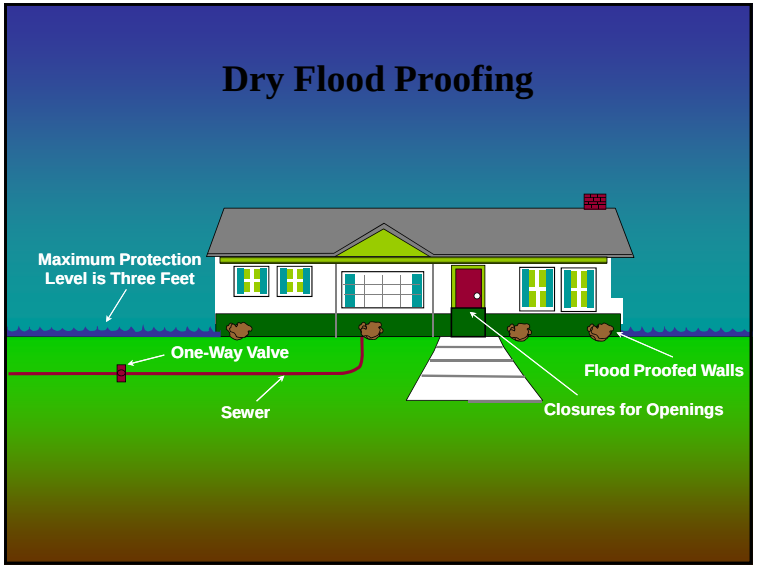
Dry Flood Proofing



Dry Flood Proofing

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Dry Flood Proofing Methods

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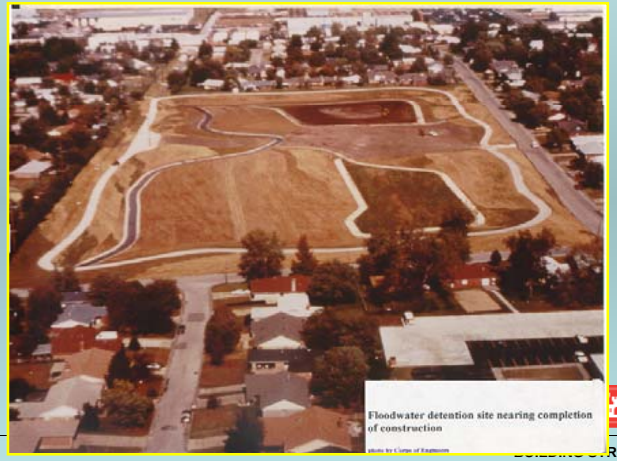
Detention Storage in Residential Area



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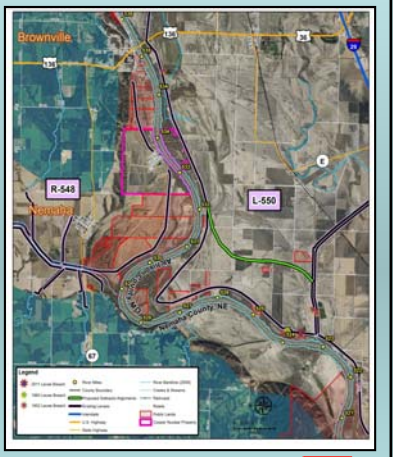
Floodplain Evacuation
(levee setback)

- **Reduces Flood Stages**
- **Reduces Erosive Velocities**
- **Increases System Reliability**
- **Increases System Sustainability**
- **Restores Historic Floodplain**
- **Economically Feasible when compared to Repairs In-Place**



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Questions / Comments

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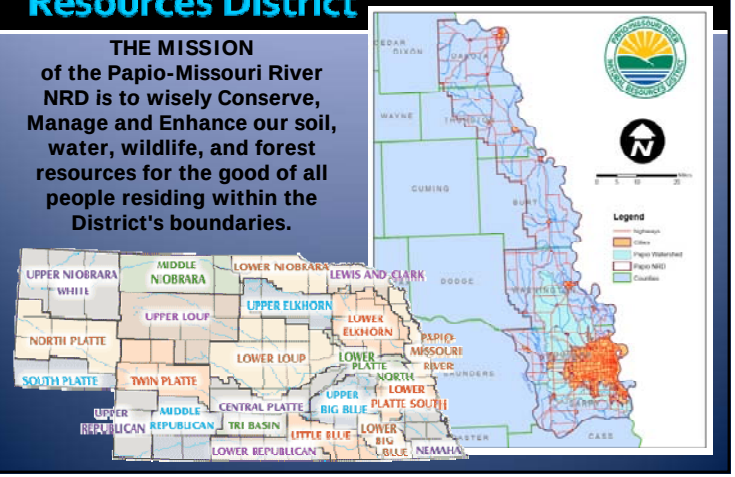
A Levee Sponsor's Perspective on

Common Financial Hurdles

Marlin J. Petermann, P.E.
Papio Missouri River Natural Resources District

Papio-Missouri River Natural Resources District

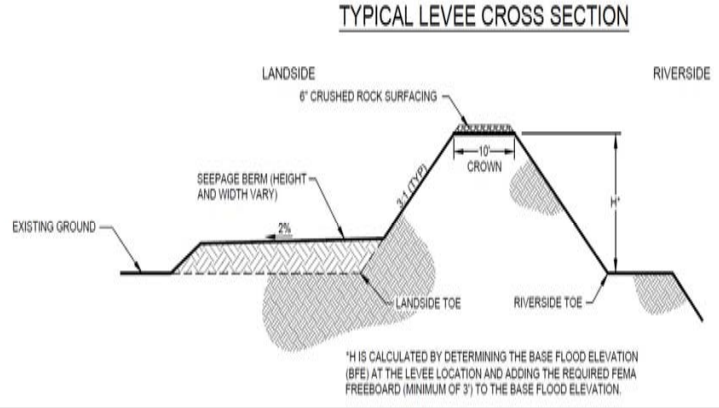
THE MISSION
of the Papio-Missouri River NRD is to wisely Conserve, Manage and Enhance our soil, water, wildlife, and forest resources for the good of all people residing within the District's boundaries.



Papio NRD Levees

- 85 Miles of levees maintained by District
- All levels of flood protection
- Inherited systems from drainage districts
- USACE federally constructed levees
- P-MRNRD constructed levees

Typical Levee Cross Section



OMRR&R

- Operation
- Maintenance
- Repair
- Replacement
- Rehabilitation

Maintenance

- Annual inspections
- Mowing
- Culvert and Closure operation /inspection
- Rock
- Seed
- Weed Spraying
- Drainage
- Bank Stabilization

Mowing & Spraying

Levee Inspection

- Annual inspections in Fall period, often including Corps of Engineers
- Periodic inspections, such as prior to storm season (April-September) and immediately following severe rainstorms by NRD
- Inspections at least daily during high water events

Drainage Structure Inspections

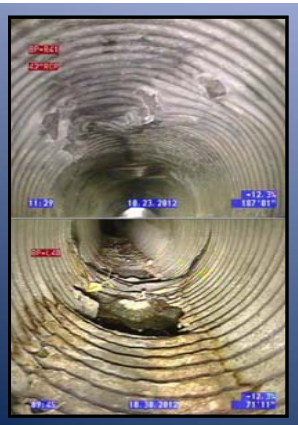
- Corps of Engineers requirement that all drainage structures through levees must be internally inspected by end of 2012 (5 yr cycle in future)
- Yearly O/M and operation of slide gates
- Reports (video and tables)

Drainage Structure-Slide Gates

Video Inspections

- Inspection Required Every 5 Years
- NRD purchase and use of pole camera and rover camera to inspect over 500 structures in 2 year period
  - Rover Camera - $60,000
  - Pole Camera - $15,000
- Can be contracted
  - LPSNRD 100 pipes inspected for $50,000

Drainage Structure Deficiencies



Maintenance – Cracks

Maintenance – Cracks

Maintenance – Rodent Holes

Maintenance Budget

- Approximately $1.3 Million budgeted annually
- 85 miles of levee
- $15,200 per mile
  - Includes materials, equipment, staff time, and contract work

Maintenance Funding

- Property tax dollars
- Improvement Project Area (IPA)

Repair, Replacement & Rehabilitation Funding

- Flood damages
  - USACE 84-99 Program
  - NRCS Emergency Watershed Protection Program
  - Federal Disaster Assistance
- Budgeted each year or set aside dollars

Repair Budget

- Approximately $300,000 per year for rip-rap
- Approximately $60,000 per year for levee top resurfacing

Repair

Union Dike – Repair of jetties and bank protection

Repair

Replacement – Ralston Creek Drainage Structure

Replacement - Ralston Creek Drainage Structure

- Replacement at Big Papio Levee
- Twin 6′ x 5′ Reinforced Concrete Box, 120′ long
- Replaced twin 6′ diamter CMP
- Construction=$271,000
- Engineering=$65,000
- Total=$336,000

Replacement – Union Dike

Replacement – Union Dike

- 48" Reinforced Concrete Pipe, 104' long
- Replaced corroded CMP pipe
- Completed 2006
- $21,000

Operation

Operation = Flood Fight

2011 Missouri River Flood

- PMRNRD $800,000 on flood fight
- USACE $1,000,000 on flood fight

Operation

Operation – Culverts

Operation – Culverts

Operation – Rodent Holes

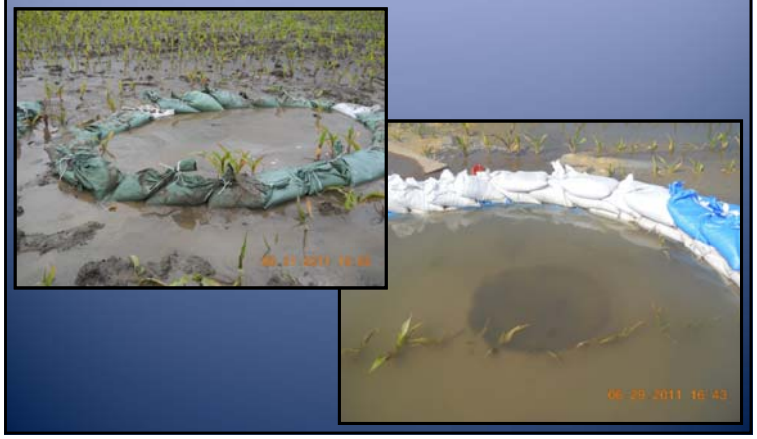
Operation – Railroad Closure

Operation – Railroad Closure

Operation – Sandbag Filling

Operation – Increase Levee Freeboard

Operation – Sandboils



Operation – Sandboils

Operation – Sandboils

Operation – Ice Jam

Repair

Major Repairs After Flood

- USACE $2,000,000
- P-MRNRD $600,000

Rehabilitation

- R-613 and R-616 will not meet FEMA Accreditation Standards
- Estimated $20,000,000 to rehabilitate both levee systems- approximately 18 miles

Questions?

For More Information:
www.papionrd.org

Non-Federal Sponsor Guide to Land Acquisition

- A major project responsibility for Non-Federal Sponsors (NFS) eligible for Federal funding involves the acquisition of real property.
- The cost-sharing provisions contained in a Project Partnership Agreement (PPA) between the Corps of Engineers and the NFS are required by the Water Resources Development Act of 1986 (Public Law 99-662).

Non-Federal Sponsor Guide to Land Acquisition

- Typically for a PPA, the NFS is required to provide all necessary lands, easements, rights-of-way, relocations, and disposal areas (LERRDs) for the construction, operation and maintenance of the project.
- These LERRDs should be retained in public ownership for uses compatible with the authorized purposes of the project.

Non-Federal Sponsor Guide to Land Acquisition

- The Omaha District has created a guide to land acquisition that provides the NFS a step by step process and samples of required documents.
- The NFS, Project Manager, and Real Estate Division must work together to develop an acquisition schedule taking into account the resources needed to accomplish the acquisition work:
  - length of time required for surveys, mapping/legal descriptions, appraisals, title evidence, negotiations and condemnation proceedings (if anticipated)

Non-Federal Sponsor Guide to Land Acquisition

- During the planning phase of the project, the most frequently overlooked real estate interests to be acquired relate to right-of-ways controlled by public utilities and local agencies.
- Additional time should be added to the acquisition schedule for possible dealings with entities such as corporations, railroads, utility companies and public agencies as they require a significant amount of time to secure approved real estate transactions.

Non-Federal Sponsor Guide to Land Acquisition

- General Acquisition steps and procedures:

Step 1 – Transmittal of final acquisition drawings from the Project Manager to the NFS

Step 2 – The first duty of the NFS is to obtain a property line survey for the project boundary

Step 3 – Real Estate Division prepares a legal description and tract map for each tract affected by the project

Non-Federal Sponsor Guide to Land Acquisition

- General Acquisition steps and procedures (cont):

Step 4 – After the identification of all LERRDs by the survey, the NFS initiates the title process in order to obtain the proof of ownership and title evidence

Step 5 – NFS enters into an agreement with a contract appraiser (to receive credit for LERRDs, appraiser must be qualified, licensed and pre-approved by Real Estate Division)

Non-Federal Sponsor Guide to Land Acquisition

- General Acquisition steps and procedures (cont):

Step 6 – NFS provides a written notice of the fair market value to affected landowners and keeps track of all negotiations

Step 7 – If NFS and the landowner cannot agree upon price, NFS has 2 options for condemnation:

1. Utilize state condemnation procedures
2. May request the Secretary of the Army institute condemnation proceedings through Real Estate Division

Non-Federal Sponsor Guide to Land Acquisition

- General Acquisition steps and procedures (cont):

Step 8 – Public Law 91-646 and the PPA require the NFS to provide relocation assistance to people and businesses that are displaced by the project

Step 9 – NFS must provide Real Estate Division a copy of all required records and submit an attorney certification letter before construction can be awarded

Non-Federal Sponsor Guide to Land Acquisition

- General Acquisition steps and procedures (cont):

Step 10 – NFS must submit claims for credit for project costs. All claims associated with the acquisition of real estate should be submitted to the Real Estate Division on a monthly basis throughout the acquisition schedule phases of the project

Non-Federal Sponsor Guide to Land Acquisition

- There is a copy of this guide to land acquisition on the CD in the folder for this levee communication seminar.

If you have any questions about the information presented, please contact me at:

Amanda.M.Simpson@usace.army.mil

or

402.995.2837

FLOOD RISK MANAGEMENT ASSOCIATED WITH LEVEES

Technical Challenges

Levee Safety Outreach , Nebraska Silver Jacket Project | Nebraska City, NE | July 10 2013

Presented by
Lalit Jha, PE, D.WRE, CFM

Agenda

- **Levee Improvements In Changing World**
  - FEMA Perspective
  - USACE Perspective
  - Levee Owners Perspective
- **Common Technical Issues**
- **Underlying Problems/Challenges**
- **Proactive Steps**

FEMA Perspective

- Identify Risk/Flood Insurance
- Publish Accurate Flood Hazard Maps
- Non-Accredited/Deficient Levees
- Evaluation of levee vs. 44 CFR 65.10 requirements

44 CFR 65.10

Structural

- Freeboard
- Closures
- Embankment Protection
- Foundation Stability
- Settlement
- Interior Drainage
- Other

- *CRITERIA PUBLISHED IN 1986

Non Structural

- General
- Operation
- Maintenance
- Other

USACE Perspective

- Maintain Levee Integrity/Construction Standards
- Responsibilities Due to Original Federal Involvement
- Accepting Improved Levee into PL 84-99 Program

5

USACE Perspective

PL 84-99 Program

- Authorized through ER 500-1-1 (Civil Emergency Management Program)
- PL 84-99 is not directly associated with FEMA levee certification
- Levee Improvements require approval from USACE
- Provide Assistance to the Levee Sponsor

6

USACE Perspective

USACE Reviews

- Modifications Related to O&M (Minor 408 Permitting)
  - Approval at District Level
- Systematic Changes to Levee Protection Level (Major 408)
  - Risk and Reliability Analysis
  - NEPA Review
  - Agency Technical Review
  - Independent External Peer Review
  - Approval at Headquarters Level

7

Levee De-Accreditation Implications

- Mandatory Purchase of Flood Insurance
  - Federally Backed Loan = Mandatory Flood Insurance
- Development Restrictions
- Property Value/Re-Sale Concerns
- Economic Development Concerns

Note: implications may be revised by new non-accredited levee mapping procedures and BW-12

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Levee Owners Perspective

Village of Waterloo, NE

- Originally Constructed in 1967 by USACE
- ~4 Mile Long Ring Levee
- Shown as Accredited Since 1980's
- Did not meet FEMA requirements
- Estimated Cost of Levee Improvements
  - $3.3 Million

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Levee Owners Perspective

City of Hooper, NE

- Originally Constructed in 1966 by USACE
- ~2 Miles Long Levee
- Shown as Accredited Since 1980's
- Did not meet FEMA requirements
- Estimated Cost of Levee Improvements
  - $1.6 Million

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Levee Owners Perspective

City of Columbus, NE

- Originally Constructed in 1972 by USACE
- ~5 Miles Long Levee
- Shown as Accredited Since 1970/80's
- Did not meet FEMA requirements
- Estimated Cost of Levee Improvements
  - $3.6 Million

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Levee Owners Perspective

Village of Howells, NE

- Primarily Constructed in 1995/96 by USACE
- ~1.25 Miles Long Levee
- Shown as Accredited Since 2000
- Did MEET FEMA requirements
- No Levee Improvements was needed

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Common Technical Issues

- Freeboard
- Geotechnical
- Flood Warning
- Interior Drainage
- Risk and Uncertainty Analysis
- Others

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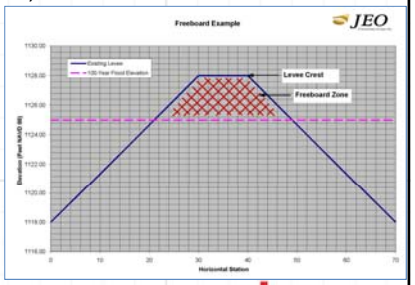
Freeboard

- Insufficient due to new flood data or change in design criteria
- Rules first implemented in 1986, however…
- Not uniformly enforced, especially for existing levees
- Older levees may have been insufficient since the initial NFIP studies



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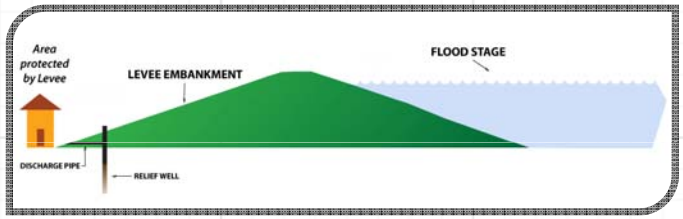
Geotechnical

- Improved Evaluation Techniques
- Seepage/Slope Stability Design Criteria



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Flood Warning

- Lack of Formal Plans/Procedures/Systems in Place
- Outdated Plans/Procedures/Implementation Tools

Photo courtesy Papio Missouri River NRD, NE

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JEO2

Interior Drainage

- Considerations
  - Potential for new SFHA
  - More detailed analysis may result in smaller SFHA (joint probability vs. 1% annual chance exceedance runoff with closed outlets)
    - Every system is unique - room for interpretation
  - Analysis can be beneficial to the community (floodplain management, compensatory storage)
  - Engage and educate the community about the process and potential outcomes
  - Seepage in addition to runoff

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Interior Drainage Analysis Results

- Council Bluffs, IA
  - 40 outlets
  - 11 pump stations
  - 3 subareas/ponding areas meet mapping criteria
  - Best available data

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Risk and Uncertainty Analysis

- Just like interior drainage there is a need to accurately identify additional risks associated with levees
- Historically flood protection has been designed based on a protection level deemed acceptable (1% annual chance exceedance)
- Usually included some form of safety factor such as freeboard

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Risk and Uncertainty Analysis

- USACE
  - Utilized in planning, design, and modification of levee improvements *(33 USC 408 November 17, 2008 memorandum)*
- FEMA
  - Freeboard accreditation criteria
    - Prescribed freeboard requirements (3-4 feet)
    - Exemptions based on uncertainty analysis (Probabilistic)

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Risk and Uncertainty Analysis

- Benefits
  - May be able to reduce freeboard requirements if Conditional Non-Exceedance Probability is greater than 95%
    - Still subject to FEMA 2-feet minimum
  - Effectively communicate risks to those protected by levees and other flood control projects (e.g., Annual Exceedance Probabilities, Long-Term Risk)

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Risk and Uncertainty Analysis

- Village of Howells, NE
- Levee has up to 1-foot of freeboard deficiency for a short length
- Risk and Uncertainty analysis indicates it passes the probabilistic freeboard requirements = No improvements

Note: Howells levee built in 1990's

Conditional Non-Exceedance Probability by Events				
4%	2%	**1%**	.4%	.2%
.9905	.9845	**.9802**	.9779	.9760

Other Issues

- Quality Geotechnical Evaluation
- Construction Operations sequencing/Scheduling
- Vegetation Removals and Management

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Underlying Problems/Challenges

- FEMA vs. USACE Regulatory Requirements
  - Neither Agency is Inclined to Respond to the Conflicts Created by the Requirements of the Other
  - An Acceptable Corps Inspection Rating, Alone, Does NOT Equate to an Accredited Levee for the NFIP
  - USACE Evaluates Operational Adequacy and Structural Stability
  - FEMA Evaluates 1% Annual Chance Flood Risk
  - Inability to Implement AR Zone

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Underlying Problems/Challenges

- Time
  - FEMA PAL Process was NOT Designed to Accommodate Improvements
- Funding
  - Little if Any Funding is Available at the National or State Levels
  - FEMA Mitigation Programs Specifically Exclude These Types of Projects
  - Communities Must Fund Improvements Themselves

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Underlying Problems/Challenges

- Issues for Levee Owners:
  - Significant costs
  - Regulatory uncertainties
- Issues for consultants
  - Regulatory uncertainties vs. giving adequate schedule, cost, and requirement information to client
  - Liability questions

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National policy and emerging issues

- Lack of clarity on national policy direction
- FEMA Non-accredited Levee Mapping Procedures
- Biggert-Waters 2012
- Railroad / Highway Embankment Issues
- Funding (or lack thereof)

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Proactive Steps – What You Can Do

- **Consider Levee as important infrastructure /investment**
  - Evaluate your levee and identify concerns
  - Audit Levee maintenance and operations plans regularly
  - Don't wait for a PAL!
- **Coordinate with Agencies Early and Often**
  - Improvement Implementation and Agency Coordination Takes Time
  - Evaluation Criteria of FEMA and USACE Are NOT the Same
  - Realize that agencies staff are implementing decisions that are made at the National Level
- **A/E firms can provide professional services to assist you**

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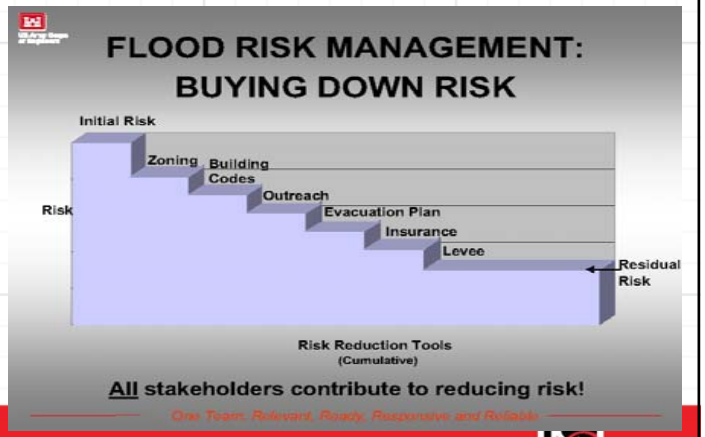
Managing Residual Risk



Graphic courtesy U.S. Army Corps of Engineers

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USACE LEVEE SAFETY PROGRAM

U.S. ARMY CORPS OF ENGINEERS **BUILDING STRONG®**

Background:

In 2006, the U.S. Army Corps of Engineers (USACE) created its Levee Safety Program with the mission to assess the integrity and viability of levees and recommend courses of action to make sure that levee systems do not present unacceptable risks to the public, property, and environment. USACE subsequently launched a major effort to establish a levee safety organization, create the National Levee Database (NLD), develop a methodology for performing technical risk assessments of existing levee infrastructure, and review and revise current related policies and procedures associated with levees.

National Levee Database and Inventory:

USACE has created a levee database model to serve as a living, dynamic database of information relative to the status and safety of the nation's levee systems. The database includes all necessary attributes of levees/floodwalls relevant to design, construction, operations, maintenance, repair, and inspections. USACE has completed inventorying all levees included in the USACE Levee Safety Program, which includes approximately 2,000 levees or 14,000 miles. USACE is currently developing an implementation strategy to provide public access to the database and to begin collecting available information on levees outside of the USACE Levee Safety Program.

Inspections:

USACE has improved levee inspection methodologies for levees in the program, which enables USACE to:

1) ensure that the levee system will perform as expected.
2) identify deficiencies or areas which need monitoring or immediate repair.
3) continuously assess the integrity of the levee system in order to identify any changes over time.
4) collect information that will inform decisions about future actions.
5) determine eligibility for federal rehabilitation funding for the levee in accordance with PL 84-99.
6) determine if the levee is being properly operated and maintained.
7) determine if the local sponsor is in compliance with the project partnership agreement, if applicable.

Levee Screening:

USACE is currently applying a screening tool to all levees in the program. This tool combines inspection data with a preliminary engineering assessment and maximizes the use of existing information and local knowledge of levee performance. Screening results will be used to rank levees by relative risk to help inform decisions about future actions to improve public safety associated with the levees.

Key Messages
❖ Public safety is the number one priority.
❖ Levees do not eliminate flood risk.
❖ Levee safety is a component of flood risk management.
❖ Both levee safety and flood risk management are a shared responsibility.
❖ Levee safety must be applied on a system-wide basis.
❖ The 1% chance event (or 100 year flood) is not a safety standard.

U.S. ARMY CORPS OF ENGINEERS
441 G. Street, NW, Washington D.C. 20314
www.usace.army.mil

LEVEE SAFETY ACTION CLASSIFICATION FACT SHEET

U.S. ARMY CORPS OF ENGINEERS – Omaha District **BUILDING STRONG®**

The US Army Corps of Engineers (USACE) works with stakeholders to assess, communicate, and manage the risks to people, property, and the environment from inundation that may result from overtopping or failure of components of levee systems. Levee Screening and Levee Safety Action Classification (LSAC) supports this mission as outlined by the National Levee Safety Act, Title IX, Section 9004 of the Water Resources Development Act of 2007.

Levee Screening supports the following principles:

- Life safety is paramount.
- Flood risk reduction infrastructure reduces risk; it does not eliminate risk—know your risk.
- Living with flood risk reduction infrastructure is a shared responsibility—know your role.
- Take appropriate actions to reduce your risk.
- Flood risk is dynamic and changes over time.

There are five action classes used in the USACE Levee Safety Program shown in the table below. The numerical value of the LSAC does not communicate risk in and by itself but should be used as the framework to discuss risk associated with levee systems and to drive actions to reduce risk. Levee Screenings are prepared by a multidisciplinary Omaha District team and presented to a national cadre of USACE subject experts. The national cadre reviews the screening for accuracy and completeness then recommends a LSAC to the Levee Safety Senior Oversight Group (LSOG). The LSOG completes their review and forwards a LSAC to the USACE Levee Safety Officer for final approval.

Levee Safety Action Classification				
Class	**Urgency**		**Characteristics***	**Actions***
I	Urgent and Compelling		Are defined as the likelihood of inundation with associated consequences characterizing each action class.	Actions recommended for each class and level of urgency.
II	Urgent			
III	High Priority			
IV	Priority			
V	Normal			

*Detailed Characteristics and Actions will be available for each LSAC

Before discussing or managing risk associated with a levee system, the risk is quantified to form a greater level of understanding. Levee Screenings are completed through the use of a Levee Screening Tool (LST) and provide a quantitative assessment of the general condition and relative risks associated with individual levee segments. A Levee Screening moves beyond inventory and inspections, which are the foundational elements of the Levee Safety Program. A Levee Screening simply asks: What is the likelihood and severity of undesirable or adverse consequences? Levee Screenings to determine general condition and relative risks and LSACs are to be considered routine management processes for levees similar to routine operation & maintenance, monitoring, and inspections.

Routine inspections, conducted annually, are a critical component of a levee safety program and focus on the operation and maintenance of the project. These annual inspections verify that the project sponsor operates and maintains the levee in accordance with the project agreement. Routine inspections result in an acceptable,

minimally acceptable, or unacceptable rating and affect the project's eligibility for federal rehabilitation assistance under the Rehabilitation and Inspection Program (authorized by Public Law 84-99), if damaged in a flood or storm event.

The periodic inspection is similar to a routine inspection and is conducted by a multidisciplinary team, led by a professional engineer. It includes a more detailed, comprehensive and consistent evaluation of the condition of the levee system. It is conducted every five years on federally-authorized levees in the PL 84-99 Program. Activity under the periodic inspection includes routine inspection items, verifies proper operation and maintenance, and compares current design and construction criteria with those in place when the levee was constructed. The final periodic inspection rating is based upon the routine inspection items, and will include an acceptable, minimally acceptable or unacceptable rating. The overall periodic inspection rating can affect the project's eligibility for federal rehabilitation assistance under PL 84-99, if damaged in a flood or storm event.

The Levee Screenings are based on the levee conditions and available data at the time of the screening. Flood loading, performance assessment, and consequence estimation are three major components of a Levee Screening. The most recent hydrologic and hydraulic information is used to determine the flood loading or the frequency of water on the levee. The most current levee inspection, performance history, flood fight records, photos, and design documentation are used in completing engineering-based performance assessments. The consequences include an estimate of life loss and direct economic damages.

The LSAC **does not** affect the eligibility of a project for repair for flood or storm damage under the PL 84-99 program. It also does not directly affect inspections, however; it may bring forth areas of focus during subsequent inspections, which need to be addressed and resolved by the levee sponsor.

The LSAC **does not** directly affect the FEMA accreditation of the levee system.

For more information regarding the LSAC, please use the contact information listed below.

Omaha District Contact Information:

Lowell Blankers	Levee Screening Facilitator	402-995-2323
Kevin Adams	Levee Screening Facilitator	402-995-2331
Bryan Flere	Levee Safety Program Manager	402-995-2227
Christopher Horihan	Rehabilitation and Inspection Program Manager	402-995-2700
Randall Behm	Flood Risk Manager	402-995-2322

Web:

HQ USACE Levee Safety Program
http://www.usace.army.mil/Missions/CivilWorks/LeveeSafetyProgram
USACE National Levee Database
http://nld.usace.army.mil
National Flood Risk Management Program
http://nfrmp.us

INCLUDED ON DATA CD

US Army Corps
of Engineers ®

LEVEE OWNER'S MANUAL FOR NON-FEDERAL FLOOD CONTROL WORKS

THE REHABILITATION AND INSPECTION PROGRAM

PUBLIC LAW 84-99

MARCH 2006

INCLUDED ON DATA CD

INCLUDED ON DATA CD

NON-FEDERAL SPONSOR GUIDE TO LAND ACQUISITION

U.S. Army Corps of Engineers
Omaha District

NOTE: This package contains samples of real estate requirements for post-PPA activities. Some of the samples herein may not be applicable to your particular project. All questions should be directed to the Omaha District Real Estate Representative or Project Manager.

INCLUDED ON DATA CD

FEMA

The National Flood Insurance Program and Levees

More than 21,000 communities across the United States and its territories participate in the National Flood Insurance Program (NFIP) by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes Federally-backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary.

Communities joining the NFIP are required to adopt floodplain management ordinances to minimize damage to properties located in the high-risk areas (known as Special Flood Hazard Areas, or SFHAs). The NFIP requires all new or substantially improved structures be constructed at or above the elevation of the one-percent-annual-chance flood, also called the base flood. Appropriate precautions should be taken by residents and business owners living or working in areas behind levees mapped as moderate-to-low risk areas because there is always a risk of overtopping or levee failure.

Levees: Risk Reduction, Not Protection

FEMA defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water in order to reduce risk from temporary flooding." Levees reduce risk from flooding events, but they do not eliminate it. There is always the chance a flood will exceed the capacity of a levee, no matter how well it is built. Levees are designed to manage a certain amount of floodwater and can be overtopped or fail during flood events exceeding the level for which they were designed. Levee failures can also be caused by structural failures resulting from improper maintenance, inadequate foundations, seismic activity, erosion, seepage, and burrowing animals. When a levee does fail, the result can be more catastrophic than if the levee had not been present.

FEMA strongly encourages citizens living and working behind levees to understand their flood risk and take action to reduce the risk to their families, businesses, and property.

Overview

The Federal Emergency Management (FEMA) administers the NFIP, the cornerstone of the Nation's strategy for assisting communities in preparing for flood disasters. The NFIP was created to help protect lives and reduce flood damages by identifying flood risks, encouraging sound community floodplain management practices, and providing flood insurance to lessen the financial impact of flooding.

While the NFIP provides flood insurance and strives to reduce flood damages through floodplain management regulations, FEMA identifies and maps the Nation's floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data necessary for floodplain management programs to ensure safer construction and for the flood insurance program to provide more accurate rating.

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Such risk reduction actions include:

- Purchase flood insurance through the NFIP
- Adhere to local floodplain management regulations when building or substantially improving your building
- Familiarize yourself with local evacuation procedures and have a family or business emergency plan in place
- Consider floodproofing and other protective measures such as elevating furnaces, water heaters and electrical panels and seal basement walls with waterproofing compounds to avoid seepage

Flood Hazard Maps Identify Flood Risks

Because floodplains change over time, flood hazard information must be periodically updated to reflect actual flood risk. FEMA is currently updating flood hazard maps, also known as Flood Insurance Rate Maps (FIRMs), Nationwide through the Risk Mapping, Assessment, and Planning (Risk MAP) program. FIRMs are the official flood maps for a community on which FEMA has identified both the high-risk and the moderate-to-low risk flood zones. With new FIRMs, community officials will have updated information to better guide where and how to build more safely, and the public will better understand their risk so they can make more informed decisions about financially protecting their homes and businesses.

Levees that are designed to provide protection from at least the base flood may be accredited by FEMA, and areas immediately behind them identified as moderate-risk zones on the FIRM. To meet FEMA's criteria for accreditation, the levee owner must provide certified documentation that the levee meets or exceeds minimum Federal requirements for reducing flood risk. If the levee owner cannot provide the necessary data and documentation for the levee, FEMA cannot accredit it and the flood risk map will show the immediate area behind the levee as a high-risk flood zone. It is important to note accrediting a levee does not guarantee protection. FIRMs carry a warning that overtopping or failure of levees is possible and flood insurance protection and adherence to evacuation procedures are strongly recommended.

Flood Insurance

Flooding is the Nation's most common natural disaster. Levees reduce the risk of flooding, but do not eliminate it. Property owners living near levees must consider the risks and take appropriate steps to protect themselves and their assets. FEMA recommends flood insurance for all property owners, especially those behind levees. Because most homeowner's insurance policies do not cover damage from floods, FEMA offers Federally-backed flood insurance through the NFIP. Low-cost flood insurance is available in areas behind accredited and provisionally accredited levees with premiums starting as low as $129 a year.

Living with Levee Systems-It's a Shared Responsibility

Ensuring the safety of lives and property in areas behind levees is a shared responsibility. FEMA identifies risk levels through flood analyses and mapping projects and establishes criteria for levee accreditation. FEMA does not build, own or certify levees. The U.S. Army Corps of Engineers (USACE) is responsible for building and maintaining USACE-owned levees and for inspecting those structures to determine their level of maintenance. States, communities, and private levee owners maintain and operate the levees they own according to their specific design criteria. Communities and their citizens are strongly encouraged to learn more about the risk associated with levees and know the steps to take to protect their families, businesses, and communities from the threat of flooding.

For More Information

- For additional information on the NFIP, please visit http://www.fema.gov/national-flood-insurance-program
- For additional information on levees, please visit http://www.fema.gov/living-levees-its-shared-responsibility.
- To see how levees work and how they can fail, please visit http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/levee_simulator.jsp.
- For additional information on flood hazard mapping, please visit http://www.fema.gov/hm-main.
- For additional information on flood insurance for your home or business or to find an agent, please visit the FloodSmart website at: www.floodsmart.gov.
- For more information about FEMA's levee accreditation process, please visit http://www.fema.gov/living-levees-its-shared-responsibility/fema-levee-resources-library#2.
- For more information about the USACE and their Levee Safety Program, please visit: www.usace.army.mil/LeveeSafety/Pages/main.aspx.

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The Facts about Levees

Those living and working in communities with levees share in the responsibility for knowing the flood risk associated with these earthen structures; their role in safeguarding their family, home, and business when one fails; and the steps to be taken now to mitigate the damages a levee can cause when overtopped or fails. The truth is levees can and do fail, but being prepared will help those affected to quickly pick up the pieces and move forward as a family and a community.

To clarify misconceptions about levees, the following facts provide the truth for living and working near levees.

MYTH: A levee is the same as a dam.

FACT: Dams and levees are an important part of our country's infrastructure; however, they are not the same. A levee is a man-made structure usually an earthen embankment, designed and constructed alongside a river or other water's edge to manage or prevent water flow into specific land regions. A dam, on the other hand, is a massive man-made barrier stretching across the length of a river or body of water to divert or capture water flow thus creating lakes and reservoirs and often providing a place for recreation and hydroelectric power for electricity. Levees help create higher, sturdier boundaries than a river's or water's natural banks and are built to reduce the risk of flooding in a community from a certain level of flooding event. They are *not* built to hold back *all* floods. Dams are built to withhold massive amounts of water, releasing only as much as their operators intend.

MYTH: I'm safe because I live behind a levee.

FACT: Over the past 30 years, on average, flooding has resulted in more fatalities in the U.S. than any other weather-related cause. Levees reduce risk from flooding events, but they do not eliminate it. There is always the chance a flood will exceed the capacity of a levee, no matter how well it is built. Levees are designed to manage a certain amount of floodwater and can be overtopped or fail during flood events exceeding the level for which they were designed. Levee failures can also be caused by structural failures resulting from improper maintenance, inadequate foundations, seismic activity, erosion, seepage, and burrowing animals. When a levee does fail, the result can be more catastrophic than if the levee had not been present. By understanding levees only reduce the risk levee associated with floods, residents, business owners, and communities can actively prepare for these events by considering protective measures such as purchasing flood insurance; flood-proofing buildings; reporting any visible levee problems; learning more about in-progress and planned projects impacting area levees;

Floods happen. Given enough time, levees will eventually be overtopped or damaged by a flood exceeding the levee's capacity or breach, resulting in significant flooding.

Levees are not floodproof. Levees reduce the risk of flooding; they do not *eliminate* the risk of flooding.

Living with levees is a shared responsibility. If you live behind a levee, you are responsible for knowing the threat you face from flooding. Do not assume someone else is doing this for you.

The actions you take today could save lives and property tomorrow. Just a few inches of water in your home or business can cause tens of thousands of dollars in damage. Be prepared for a flood. Buy flood insurance now as there typically is a 30-day waiting period before coverage becomes effective.

For More Information

FEMA has a variety of resources available to provide you with more information to help you understand levees and the flood risk behind them.

- For more information about being prepared before, during and after a flood, visit: http://www.fema.gov/national-flood-insurance-program
- To see how levees work and how they can fail, visit http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/levee_simulator.jsp.
- For more information on levees, please visit http://www.fema.gov/living-levees-information-homeowners-renters-business-owners-and-general-public
- For more information on flood insurance for your home or business or to find an agent, please visit the FloodSmart website at: www.FloodSmart.gov
- For more information on flood hazard mapping, please visit: http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping
- To find your home on a FIRM, visit the FEMA Map Service Center at: www.msc.fema.gov

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and adhering to local floodplain management regulations and evacuation procedures. As a home or business owner, the better prepared you are, the more quickly you will recover when the next flood occurs.

MYTH: Levees last forever, whether maintained or not.

FACT: Like most structures, levees decay over time and do not always perform as intended. Some levees were originally built by citizens to protect their properties from flooding while others were subsequently built by various Federal, State or local entities. The levee owner is responsible for ensuring the levee is maintained and operated properly. They are also responsible for providing the Federal Emergency Management Agency (FEMA) evidence from a licensed Professional Engineer or Federal agency the levee meets current design, construction, maintenance, and operation standards to provide protection from the one-percent-annual-chance flood, known as the base flood.

MYTH: If a levee fails the government will bail me out.

FACT: The Federal government can provide assistance only when a disaster is declared by the President; consequently, it is not always available. When declared, assistance usually takes the form of a low-interest loan which individuals must repay, in addition to making their existing mortgage payments. A few inches of floodwater can cause tens of thousands of dollars in damage. And as the water rises, so too will the costs.

The government's job is to make citizens aware of their risk. Most local officials have adopted protocols and procedures for ensuring public safety. However, *ensuring public safety is everyone's responsibility.*

At highest risk are residents who live in floodprone areas and have a structure that, if flooded, would be expensive or impossible to replace. FEMA encourages citizens and communities to prepare for a flood, the most common and widespread of all natural disasters. There are many steps one can take to reduce the risk from floods caused by a levee failure, including:

- Learn more about in-progress and planned levee projects that may have an impact on your flood risk
- Purchase flood insurance from the National Flood Insurance Program (NFIP), even if you live in a moderate- or low-risk area behind an accredited levee
- When building or substantially improving your building, adhere to local floodplain management regulations
- Familiarize yourself with local evacuation procedures and have a family or business emergency plan in place
- Consider floodproofing and other protective measures such as elevating furnaces, water heaters and electrical panels and seal basement walls with waterproofing compounds to avoid seepage

If you live behind a levee, you are responsible for knowing the threat you face from flooding. Do not assume someone else is doing this for you.

MYTH: FEMA owns and operates levees.

FACT: Nearly 85 percent of levees are *locally* owned and maintained. The rest are overseen by the U.S. Army Corp of Engineers (USACE) or other Federal or State agencies. FEMA does not build, own, operate, maintain, or certify levees. It is the responsibility of the levee's owner (e.g., local community, county, levee board, State, USACE) to provide to FEMA evidence from a licensed Professional Engineer or Federal agency that the levee meets or exceeds minimum Federal requirements for reducing flood risks. FEMA's levee responsibilities include identifying flood hazards and assessing flood risks in levee-impacted areas and overseeing the NFIP. More specifically, FEMA performs the following activities:

- Determines and establishes appropriate flood risk zone designations in areas behind levees and reflects those zones on Flood Insurance Rate Maps (FIRMs); and
- Establishes mapping standards (design, operations, and maintenance criteria) to accredit levees that reduce the risks associated with at least the base flood.

FEMA is *not* authorized to:

- Implement or fund the design, construction, certification, operation, or maintenance of levee systems,
- Inspect or evaluate levee systems, or
- Determine how an individual structure or system will perform during a flood event or provide the funding for such a determination.

Levee owners and/or the community are responsible for operating and maintaining levees so they continuously provide at least the minimum Federal requirement for reducing the risk of flooding for citizens living and working behind a levee.

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The NFIP and Levee Systems Frequently Asked Questions

Q: What is a levee?

A: A levee is a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide risk reduction from temporary flooding.

Q: What is a levee system?

A: A levee system is a flood risk reduction system that consists of a levee, or levees, and associated structures. These include closure and drainage devices, which are constructed and operated in accordance with sound engineering practices.

Q: How are levees different from dams and other flood risk reduction structures?

A: A levee is built parallel to a waterway (most often a river) in order to protect lives and properties behind it from some level of flooding. A dam built for flood risk reduction is usually designed to lower the amount of water going downstream of the dam during a flood by containing excess water and releasing it slowly over time. Unlike most levees, dams may serve purposes other than flood control, such as providing water for irrigation, community water supplies, recreation, and hydroelectric power.

A second type of flood risk reduction structure is the floodwall, which the Federal Emergency Management Agency (FEMA) considers and assesses the same as a levee for risk identification purposes. Floodwalls, similar to levees, are built parallel to a waterway in order to reduce risk from flooding. They are usually found in more urban areas and are made of stone or concrete.

Need more information on levee systems?

Please visit the levee-dedicated pages on the FEMA Website at: www.fema.gov/plan/prevent/fhm/lv_intro.shtm.

Here you will find an array of guidance and information resources to better answer any questions you might have on levee systems.

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Q: When were levees first constructed? Why have we become dependent on levees and levee systems?

A: Levees were first built in the United States more than 150 years ago. Farmers, traditionally drawn to the rich soils of floodplains, put many levees in place to protect agricultural areas from frequent flooding. Since then, other levee systems have been built to protect urban areas and these systems have typically been built to higher standards used by the U.S. Army Corps of Engineers (USACE). As rural areas of the United States have undergone development and urbanization, businesses and homes have increasingly replaced farms, and now there are properties located behind levee systems that may not provide a sufficient level of flood risk reduction. Both lives *and* properties landward of many of the Nation's levee systems—that is, in levee-impacted areas—now depend on an adequate assessment of the current level of risk reduction provided and the related flood risks.

Q: Why is it important to understand the risks associated with levee systems?

A: With thousands of miles of levee systems in the United States impacting millions of people, it is vital for individuals to understand the risks associated with living or working in levee-impacted areas and the steps they can take to mitigate these risks. Everyone should understand that no levee system provides full risk reduction from all flood events. Even the best flood risk reductions system cannot completely eliminate the risk of flooding. Levee systems are designed to provide a *specific level of risk reduction* and larger flood events can cause levees to be overtopped or fail. Levee systems also decay and deteriorate over time, so regular maintenance and periodic upgrades are needed to ensure a levee retains its level of risk reduction and continues to perform as designed. When levee systems do fail, they often fail catastrophically – the resulting damage, including loss of life, may be more significant than if the levee system had not even been built.

Q: Who is responsible for building and maintaining the levee systems?

A: Usually, no one entity is solely responsible for levee system design, construction, operation, and maintenance. Some levee systems were originally built by citizens to protect their properties from flooding. Others were built by various Federal, State, or local entities. The USACE has designed and built many of the Nation's levee systems and is responsible for the maintenance of federally owned levees that are in the USACE program. Not all of the levee systems built by the USACE are federally owned, however. In most instances, levee system ownership has been transferred to the State or to another local or regional authority, which then becomes responsible for documenting, operating, and maintaining the levee system.

Q: Is the current interest in levee system safety related to Hurricane Katrina?

A: The devastation caused by Hurricanes Katrina and Rita brought the issues of levee system policy, flood hazard management, and flood insurance to the forefront of public debate and discussion. However, as administrator of the National Flood Insurance Program (NFIP), FEMA has long been concerned with the reduction of the risk to life and property in levee-impacted areas. In recognition of the importance of accurate risk assessment for the areas impacted by the thousands of miles of levee systems across the United States, FEMA established detailed requirements,documented in the *Code of Federal Regulations* at Title 44, Chapter 1, Section 65.10,to guide the evaluation of levee systems and the mapping of levee-impacted areas on NFIP flood maps in 1986. To assure standard levee system evaluation and mapping practices, FEMA issued guidance to its contractors and mapping partners. This guidance can be found in Appendix H of the comprehensive *Guidelines and Specifications for Flood Hazard Mapping Partners*. FEMA issued Procedure Memorandum 34 (PM 34) — *Interim Guidance for Studies Including Levees*— on August 22, 2005, before Hurricane Katrina hit the Gulf Coast, which re-emphasized FEMA's 20-year old levee system evaluation and mapping policy and regulations and provided additional guidance to help communities and other levee owners meet NFIP standards.

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Q: What is FEMA doing to address levee system issues?

A: FEMA does not build, maintain, or certify levee systems. FEMA is responsible for identifying flood hazards and assessing flood risks in levee-impacted areas through engineering studies and mapping projects, including updating the existing NFIP flood maps. In addition, FEMA has established criteria for recognizing levee systems as providing a 1-percent-annual-chance or greater level of flood risk reduction. However, FEMA does not actually *examine or analyze structures* to determine their condition or how they will perform during a given flood event. FEMA relies on communities and other levee owners to provide data and documentation showing that a levee system meets NFIP design, operations, and maintenance criteria. If the levee system does not meet these regulatory criteria, FEMA will show the levee system not providing 1-percent-annual-chance flood risk reduction on the FIRM. In addition to identifying risks in levee-impacted areas, FEMA works in conjunction with its Federal, State, local, and professional/technical partners to bolster flood risk mitigation in communities nationwide. Finally, because the risks associated with levee systems are real FEMA strongly encourages flood insurance, risk reduction, adherence to evacuation procedures, floodproofing, and other protective measures in *all* levee-impacted areas, even for those that are accredited. FEMA emphasizes the need for property owners to consider such measures through notes on affected FIRM panels.

Q: What does it mean for a levee system to be certified? How is accreditation different?

A: A levee system is certified if evidence,typically a statement by a licensed professional engineer or Federal agency responsible for levee system design,has been presented showing that the system meets current design, construction, maintenance, and operation standards to provide risk reduction from the 1-percent-annual-chance flood. The levee owner is responsible for ensuring that the levee system is being maintained and operated properly and for providing evidence of certification. If the levee satisfies the regulatory design, maintenance, and operation criteria FEMA will "accredit" the levee system as providing adequate risk reduction on the FIRM and the levee-impacted area will be shown as a moderate-risk area, labeled Zone X (shaded). FEMA will only accredit a levee system that meets NFIP criteria, which can be found by visiting http://www.fema.gov/library/viewRecord.do?id=2741.

Q: What happens if a levee system cannot be certified? How does this impact the FEMA accreditation and mapping process?

A: FEMA has a responsibility to the public to identify the risks associated with levee systems that have not been certified or that have lost certification. If a levee system cannot be certified as providing risk reduction from the 1-percent-annual-chance flood FEMA will not accredit the levee system or will de-accredit a levee system that had previously been shown as providing a 1-percent-annual-chance level of flood risk reduction on an NFIP map. Because FEMA will not accredit uncertified levee systems these systems will not be depicted on FIRMs as providing a 1-percent-annual-chance level of risk reduction. FEMA will remap the levee-impacted areas landward of these levee systems as high-risk areas, called Special Flood Hazard Areas (SFHAs). Flood insurance is required in SFHAs for any mortgage that is federally backed, regulated, or insured. It is important to note that neither certification nor accreditation guarantees protection from a given flood event. All FIRM panels showing accredited and provisionally accredited levee systems will carry notes indicating that overtopping or failure of any levee system is possible. FIRM panels will also note that flood insurance, risk reduction, floodproofing, and other protective measures in *all* levee-impacted areas should be considered.

Q: What is a Provisionally Accredited Levee (PAL) designation?

A: A levee owner's failure to provide full documentation of a levee system's status does not mean that the levee system does not provide the designed level of risk reduction. It also does not mean that the FIRM should show the levee system as providing 1-percent-annual-chance flood risk reduction. FEMA created the PAL designation to facilitate the certification and accreditation process for communities with levee systems that are *reasonably expected to continue to provide* 1-percent-annual-chance flood risk reduction.

The clarified procedures for PALs are documented in FEMA Procedure Memorandum No. 43 (PM 43)—*Guidelines for Identifying Provisionally Accredited Levees*—dated March 16, 2007.

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A PAL is a designation for a levee system that FEMA has previously accredited with providing 1-percent-annual-chance flood risk reduction on an effective FIRM and for which FEMA is awaiting certified data and/or documentation that will show that the levee system is in compliance with NFIP regulations. Before FEMA will apply the PAL designation to a levee system, the community or levee owner will need to sign and return an agreement that indicates that the data and documentation required for compliance with the NFIP regulations will be provided within a specified timeframe, which depends on the levee system's status, but will be no longer than 24 months. On a FIRM, a PAL is shown as providing 1-percent-annual-chance flood risk reduction and the impacted area landward of the PAL is shown as a medium-risk area, labeled Zone X (shaded), except for areas subject to residual flooding, such as ponding areas, which will be shown as high-risk areas (i.e., SFHAs). A note clarifying the provisional nature of the PAL designation and the Zone X (shaded) area will also be provided on the FIRM.

Q: How do the PAL designations for levee systems affect the communities in which they are provided?

A: Providing communities with current flood risk information is one of the primary goals of the NFIP and the Risk MAP effort. In order to meet this goal, the status of levee systems providing 1-percent-annual-chance flood risk reduction needs to be taken into account. However,gathering all data and documentation for a leveee system can sometimes take months,which could delay the issuance of FIRMs and provide citizens with out of date information on which to base decisions to reduce their flood risk ,including the purchase of flood insurance. The PAL designation allows the map release and review process to proceed while data and documentation are being gathered. The previously cited note on the FIRM alerts community officials and the public to the levee system's provisional status and associated risks—including the potential risk of overtopping. FEMA updated the levee notes that will appear on the FIRMs by issuing Procedure Memorandum No. 45—*Revisions to Accredited Levee and Provisionally Accredited Levee Notations* on May 12, 2008.

Q: What if the levee system has maintenance deficiencies?

A: For levee systems in the USACE Program, the USACE has initiated a national levee inventory and assessment program to identify the condition, location, level of risk reduction, and maintenance activities of all USACE levees. This inventory assists in the assessment of the risk to public safety associated with levee systems nationwide and FEMA is working with the USACE throughout the inventory and assessment phase and coordinating this effort with FEMA's mapping activities.

For levee systems within its program, the USACE determines which levee systems will be offered a one-time-only 1-year "maintenance deficiency correction period." This period was established to allow public sponsors/levee owners to correct levee system maintenance deficiencies before the levee system is placed in an inactive status in the USACE Rehabilitation and Inspection Program and becomes ineligible for Public Law 84-99 rehabilitation assistance.

For maintenance-deficient levees *not* in the USACE program, PM 43 allows for a one-time-only 1-year maintenance deficiency correction period. This 1-year period provides the levee owner and/or community with the time necessary to correct the maintenance deficiencies and provide data and documentation demonstrating that these deficiencies have been corrected. If that information is submitted within the 1-year timeframe the levee system could be eligible for the PAL designation.

However, if the documentation is not submitted within the 1-year timeframe, then the area will be mapped as high risk and flood insurance will be required for buildings behind the levee with a federally regulated loan .

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Q: What qualified as a USACE Program Levee System?

A: Levee systems within the USACE Program included (and continue to include) the following:

- Levee systems built by the USACE that were authorized for construction by the U.S. Congress or by USACE continuing authorities (e.g., Section 205);
- Levee system projects constructed by non-Federal interests or other (non-USACE) Federal agencies and incorporated into the USACE Federal system by specific congressional action; and
- Federal projects that are either operated and maintained by the USACE or turned over to a local sponsor for operation and maintenance; and Non-Federal projects within the Rehabilitation and Inspection Program (Public Law 84-99).

Q: Where can I go for more information about a levee system in my area?

A: You can find additional information about a levee system in your community from several locations:

- **Check the current FIRM for your community to see if a levee system or other flood risk reduction system is already shown as providing 1-percent-annual-chance flood risk reduction**. Community officials will have copies of the FIRM on file in the Community Map Repository. To learn the location of the Community Map Repository in your community, please call the FEMA Map Assistance Center, toll free, at 1-877-FEMA MAP (1-887-336-2627). You can also view the effective FIRM for your community on the FEMA Map Service Center Website, located at http://msc.fema.gov, or you may order your own copy by calling the FEMA Map Information eXchange, toll free, at 1-877-336-2627.
- **Call your local officials to request information about levee systems in your area**. Because most levee ownership and maintenance responsibilities have been turned over to communities, local agencies should have information about the levee system, including its operations and maintenance schedule.
- **Check with your local USACE district office**. To find your local USACE district office, please visit http://www.nfrmp.us/guidance.cfm. The USACE will have information about any federally owned levee systems in your area and possibly additional information about other levee systems.

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Levee Mapping - Complying with 44 CFR 65.10

What are the Requirements of 44 CFR 65.10?

In order for a levee to be accredited by FEMA and shown on a FIRM as providing protection from the base flood, a levee must first be certified by a Professional Engineer or a Federal Agency that designs levees. Levees are accredited when levee owners, communities, or other interested parties provide appropriate data and documentation demonstrating compliance with 44 CFR 65.10 in the following five areas: General Criteria, Design Criteria, Operation Plans and Criteria, Maintenance Plans and Criteria, and Certification Requirements. Communties with levees are not required to demonstrate compliance with 44 CFR 65.10, but must do so for any levee the wish to have recognized on a FIRM.

General Criteria

FEMA will recognize only those levees that meet, and continue to meet, minimum standards consistent with the level of protection sought through comprehensive floodplain management criteria found in 44 CFR Section 60.3.

Design Criteria

A registered Professional Engineer must certify data and documentation demonstrating the structural design criteria are met. The submitted documentation must include certified "as built" plans. Additionally, recent photographs of the levee, including embankments and levee closures, while not required, will be helpful to FEMA in performing the review. Mandatory information includes:

- Freeboard design, including that for riverine and coastal levees
- Closure designs showing all openings have closure devices, closures are designed according to sound engineering practice and are a structural part of the levee during operation
- Embankment protection demonstrating no appreciable erosion of levee embankment during the base flood

Code of Federal Regulations

Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR 65.10) is titled, "Mapping of areas protected by levee systems." It provides the minimum design, operation, and maintenance standards levees must meet and continue to meet in order to be recognized as providing protection from the base flood (also known as one-percent-annual-chance flood) on Flood Insurance Rate Maps (FIRMs).

The Federal Emergency Management Agency (FEMA) recognizes (accredits) levees based on data and documentation provided by a community or other responsible party.

FEMA review is solely for establishing flood hazard zones and does not constitute a determination as to how a levee will perform during a flood event. If a levee is accredited, FEMA will reflect the levee as providing protection from the base flood on the FIRM.

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- Embankment and foundation stability analyses evaluating expected seepage during base flood loading conditions, including flooding depth, duration, penetrations, and other seepage and stability factors
- Settlement analysis assessing potential freeboard loss due to settlement, showing that minimum freeboard will be maintained
- An interior drainage analysis identifying the source(s) and magnitude of interior flooding performed by a registered Professional Engineer
- In some unique situations FEMA may require additional design critera to ensure the levee provides adequite risk reduction

Operations and Maintenance Plans and Criteria

The Operations and Maintenance (O&M) plans must include information fulfilling the minimum requirements of 44 CFR 65.10(C) and 44 CFR 65.10 (D). The O&M of the levee must be under the jurisdiction of an approved agency and officially adopted by that agency. Official adoption generally requires a vote by a governing body.

Certification Requirements

Data submitted to support a given levee complies with the structural requirements outlined above must be certified by a registered Professional Engineer, along with certified as-built plans for the levee. Certification, as defined in 44 CFR 65.2(b), is a statement that the submitted information is accurate and in accordance with sound engineering practices.

Accredited Levees Still Present Residual Risks

Even after the Professional Engineer certification and FEMA accreditation processes are completed, there is still a flood risk associated with levees. While levees are designed to reduce risk, even properly maintained levees can fail or be overtopped by large flood events. *Levees reduce risk, they do not eliminate it.*

Many communities and public agencies seek the minimum one-percent-annual-chance level of flood risk reduction. However, this cannot be viewed as a health and safety standard; it is simply a level of flood risk.

Living with Levees – It's a Shared Responsibility

FEMA and other government agencies are working to make citizens aware of their risk through various forms of outreach including fact sheets such as this. Most local officials have adopted protocols and procedures for ensuring public safety and individual property owners are learning more about their risk and the steps for protecting their families, businesses, and communities from the threat of flooding. Remember, levees are not fail proof – protect your future by knowing your flood risk, knowing your role in reducing the risk from flood, and taking the steps today to ensure the safety of lives and property in areas behind levees.

For More Information

- To review 44 CFR, please visit: www.access.gpo.gov/nara/cfr/waisidx_00/44cfrv1_00.html.
- For a formatted version of 44 CFR 65.10, it can be downloaded at: www.fema.gov/library/viewRecord.do?id=2741.
- For additional information on levees, please visit: www.fema.gov/living-levees-its-shared-responsibility.
- For additional information on flood hazard mapping, please visit: http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping.

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Levee Certification vs. Accreditation

What is Levee Certification?

Levee certification is the process that deals specifically with the design and physical condition of the levee, and is the responsibility of the levee owner or community in charge of the levee's operations and maintenance. Certification must be completed for the levee to be eligible for accreditation by the Federal Emergency Management Agency (FEMA). Certification consists of documentation, signed and sealed by a registered Professional Engineer, as defined in Chapter 44 of the Code of Federal Regulations (44 CFR), Section 65.2. This documentation must state the following:

- The levee meets the requirements of 44 CFR, Section 65.10
- The data is accurate to the best of the certifier's knowledge
- The analyses are performed correctly and in accordance with sound engineering practices

This documentation is provided to FEMA to demonstrate that a registered Professional Engineer certified the levee, and meets the specific criteria and standards to provide risk reduction from at least the one-percent-annual-chance flood. Once the levee meets the other requirements of 44 CFR 65.10, FEMA can accredit the levee and show the area behind it as being a moderate-risk area on a Flood Insurance Rate Map (FIRM). If a community or levee owner wants the area behind a levee to be shown as reducing risk from the one-percent-annual-chance flood, they must first complete the process for having the levee certified.

How is a Levee Certified?

To certify a levee, the community or levee owner must work with a licensed engineer or a Federal agency responsible for levee design to develop and certify documentation that the levee meets design construction standards for at least the one-percent-annual-chance flood. *Levee certification does not warrant or guarantee performance*, and it is the responsibility of the levee owner to ensure the levee is being maintained and operated properly.

Levees

FEMA defines a levee as a "man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide a level of protection from temporary flooding."

Levees reduce the risk of flooding, but do not eliminate all flood risk. As levees age, their ability to reduce this risk can change and regular maintenance is required to retain this critical ability. In serious flood events, levees can fail or be overtopped and, when this happens, the flooding that follows can be catastrophic.

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What is Accreditation?

A levee cannot be accredited until the certification process is completed. FEMA accredits a levee as providing adequate risk reduction on the FIRM if the certification and adopted operation and maintenance plan provided by the levee owner are confirmed to be adequate. An operations and maintenance plan specifies key operating parameters and limits, maintenance procedures and schedules, and documentation methods. FEMA's accreditation is not a health and safety standard – it only affects insurance and building requirements.

An area impacted by an accredited levee is shown as a moderate-risk area, and is labeled Zone X (shaded) on a FIRM. In this case, the National Flood Insurance Program (NFIP) floodplain management regulations do not have a mandatory flood insurance purchase requirement. However, FEMA recommends the purchase of flood insurance due to the risk of flooding from potential levee failure or overtopping.

If the levee is not accredited, the area will be mapped as a high-risk area, known as a Special Flood Hazard Area, or SFHA. In this case, the NFIP floodplain management regulations must be enforced and the federal mandatory purchase of flood insurance applies.

FEMA's Role

FEMA does not own, operate, maintain, inspect, or certify levees. FEMA's role is limited to identifying and mapping the level of flood risk associated with levees and only accredits them where data showing compliance with 44 CFR 65.10 is provided by the community, levee owner, or other interested parties. FEMA has a responsibility to the public to identify the risks associated with levees that are either not certified or no longer compliant with 44 CFR 65.10. Areas behind non-accredited levees will be shown on FIRMs as a high-risk floodplain.

What is a Provisionally Accredited Levee or PAL?

FEMA created the PAL designation to facilitate the certification and accreditation process for communities unable to readily provided certification documents, but who reasonably expect levees in the community to provide one-percent-annual-chance flood risk reduction. A PAL is a designation for a levee that FEMA previously accredited on an effective FIRM, and is now awaiting certified data and/or documentation to show the levee remains compliant with NFIP regulations. Levees with structural deficiencies are not eligible for the PAL designation. However, a PAL may include a 12-month period for the correction of maintenance deficiencies.

A community or levee owner's failure to provide full documentation of the status of a levee does not mean the levee doesn't provide the designated level of risk reduction. However, it does impact how the levee will be mapped on a FIRM because it will be de-accredited, and the impacted area will be mapped as an SFHA.

Before FEMA will apply the PAL designation to a levee, the community or levee owner must sign and return an agreement that indicates the data and documentation required for accreditation will be provided within 24 months or less. The procedures for PALs are clarified and documented in FEMA Procedure Memorandum No. 43, *Guidelines for Identifying Provisionally Accredited Levees*.

For More Information

Living with levees is a shared responsibility. It is important for both levee owners and those who live and work near levees to understand the risk associated with levees. FEMA has a number of resources available for further information about levees, including the certification and accreditation process. Below are links to additional information:

- A levee-specific webpage has been set up on the FEMA.gov. Please visit http://www.fema.gov/living-levees-its-shared-responsibility.
- For additional information on NFIP criteria for accrediting levees, visit: www.fema.gov/library/viewRecord.do?id=2517.
- For more background on Provisionally Accredited Levees, download the fact sheet at: www.fema.gov/library/viewRecord.do?id=1987.
- For more specific information regarding levee construction and restoration, visit:http://www.fema.gov/living-levees-its-shared-responsibility/levee-system-construction-restoration-projects
- For additional information on Procedure Memorandums visit: http://www.fema.gov/ctp-main/guidelines-specifications-flood-hazard-mapping-partners.

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History of Levees

Water is an essential resource which life depends on. Civilizations of past have evolved to exist around water as it provides a source of food, transportation, and trade. Today's society is no different as millions of people throughout the United States live or work within a floodplain, vastly increasing the risk from flooding events.

The Federal Emergency Management Agency (FEMA) defines levees as man-made structures designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water in order to reduce the risk from temporary flooding. Introduced in the mid to late 19th century, many levees were originally designed to just prevent flooding on prime agricultural farmland; however these same levees today are now considered to be urban levees as a result of residential and commercial development in those areas.

Early Twentieth Century

Throughout the early 20th century, devastating and costly floods led Congress to pass the Flood Control Act of 1917. The provisions of the Act were designed to reduce flood damage along the Mississippi, Ohio, and Sacramento Rivers. Specifically, it authorized flood control work outside the Mississippi Valley, directed local communities to contribute half the cost of constructing a levee, and required these communities to maintain the levees once construction was complete.

The Flood Control Act of 1928 brought a long period of unregulated and poorly constructed levees into focus by expanding the flood control policy to include floodways, spillways, and channel improvements. Additionally, it authorized the U.S. Army Corps of Engineers (USACE) to design and construct flood control projects and emphasized the requirement for local communities to perform post-construction operation and maintenance for flood control levees. A key provision of this Act stated the U.S. Government could not be held liable for any damage from or by floods.

The Flood Control Act of 1936 recognized flood control as a national priority. The Act authorized the USACE and other agencies to construct flood control structures such as levees and flood walls, and perform channel improvements. Additionally, it committed the Federal government to protect people and property.

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1960s to 1980s: Defining the One-Percent-Annual-Chance Flood

From the 1960s to 1980s, new National policies required flood control levee projects to be designed to hold the one-percent-annual-chance event, which was chosen to be the regulatory flood protection level for flood insurance purposes. This flood protection level unintentionally created the misleading belief by U.S. citizens that the structure was safe to the one-percent-annual-chance or what was also known as "the 100-year flood."

The National Flood Insurance Program (NFIP) was enacted by Congress in 1968. This program provided for people who live in areas around levees or in areas with the greatest risk of flooding, called Special Flood Hazard Areas (SFHAs), the ability to purchase affordable flood insurance. Later, Congress established that flood insurance be required on buildings located in the SFHA and secured with loans through Federally regulated or insured lenders.

In 1981, FEMA stated using the one-percent-annual-chance standard was encouraging the construction of levees for the sole purpose of removing the SFHA designation so building owners would not be required to purchase flood insurance. They asserted crediting a levee system with this level of protection violated the spirit of the National Flood Insurance Act. Finally in 1986, FEMA established detailed requirements, documented in the Code of Federal Regulations (CFR) 65.10, to guide the evaluation of levee systems and the mapping of levee impacted areas on the FEMA Flood Insurance Rate Map (FIRM).

Present Day

In 2007, Congress passed the National Levee Safety Act, a key element of the Water Resources Development Act of 2007. This element sought the collection and documentation of basic information relative to Federal levees (database, inventory, inspection, and assessments).

In 2011, U.S. Senate and House members requested FEMA reconsider its policy regarding the depiction of flooding associated with non-accredited levees in order to more precisely reflect the impact of non-accredited levees on the adjacent flood hazards. A non-accredited levee is one that has not been demonstrated to meet FEMA standards as outlined in 44 CFR Section 65.10 regarding the ability to protect against the base flood. FEMA is working with the USACE as well as public and private stakeholders to establish updated procedures for mapping levees and levee systems to address the concerns of Congress.

For More Information

It is a shared responsibility of community officials, stakeholders, media, and the public to understand and properly communicate the risk associated with living and working behind levees. There is a variety of resources available to provide more information about levees.

- For more information on levees from FEMA, visit: www.fema.gov/living-levees-its-shared-responsibility.
- For FAQs on levees, visit: www.fema.gov/living-levees-its-shared-responsibility/fema-levee-resources-library.
- To see how levees work and how they can fail, visit: www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/levee_simulator.jsp.
- For more information about the National Committee on Levee Safety, visit: www.leveesafety.org/.
- For information about the U.S. Corps of Engineers' Levee Safety Program, visit: www.usace.army.mil/LeveeSafety/Pages/main.aspx.

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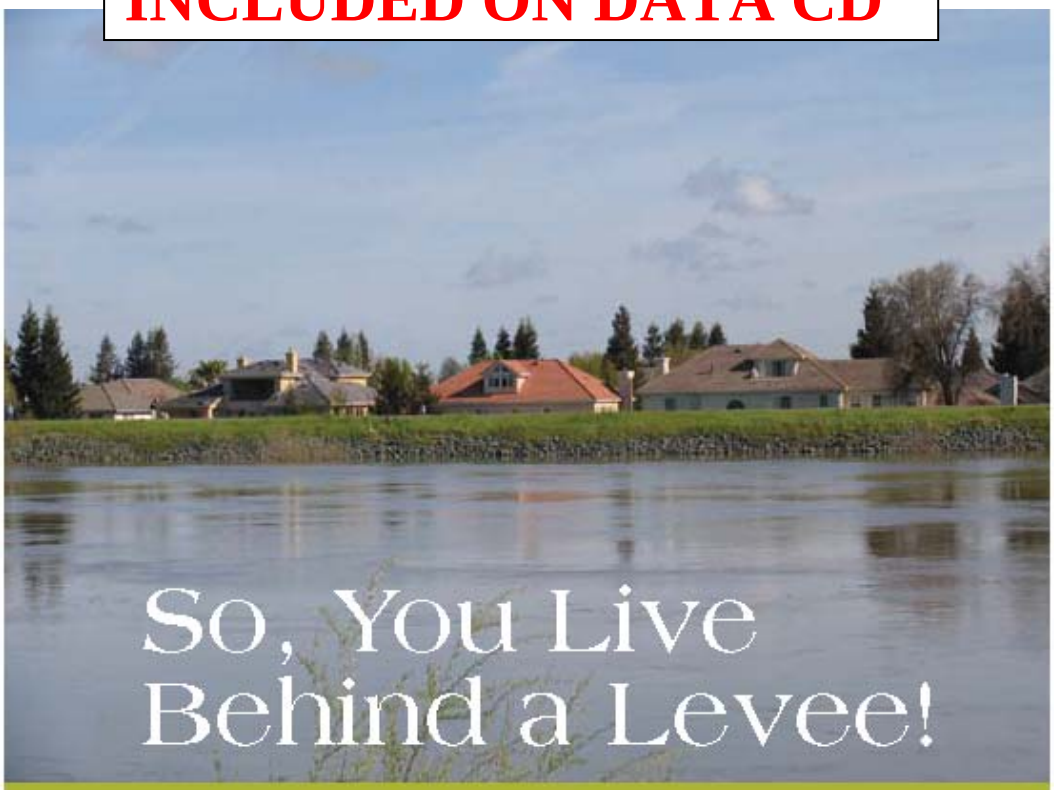
INCLUDED ON DATA CD



So, You Live Behind a Levee!

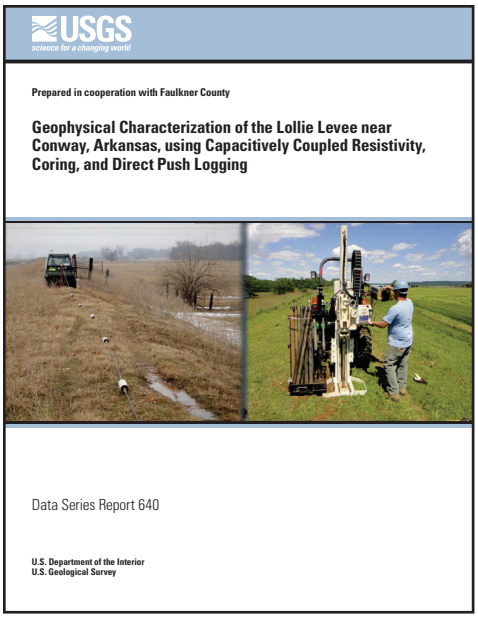
What you should know to protect your home and loved ones from floods

INCLUDED ON DATA CD

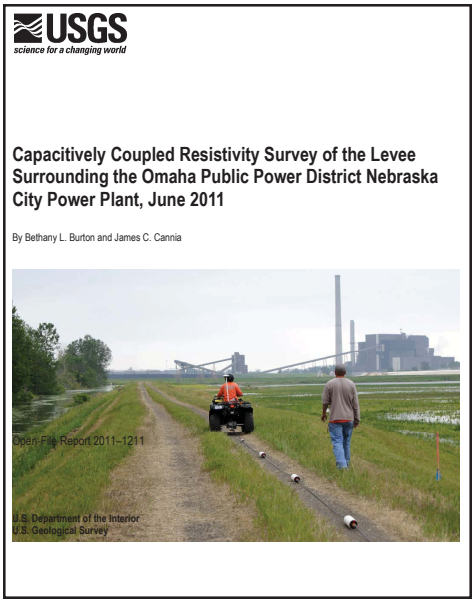
Surface Geophysical Capabilities

The U.S. Geological Survey Nebraska Water Science Center has worked with other Federal and local partners using surface geophysical techniques to characterize levee materials. Surface geophysical techniques, such as direct-current or capacitively coupled resistivity, have been used in the past to characterize levee materials and the underlying floodplain sediments allowing managers to evaluate potential weak points. Additionally these techniques can also be used to identify suitable source material for the construction of new levees.

Many levees are constructed on complex assemblages of clay, silt, sand, and gravel. Sand deposits are susceptible to preferential scour during high-water events. Additionally, locally sourced materials used for levee construction may contain materials that could weaken the levee. As such, it is important to know the distribution of geologic materials under levees to evaluate potential weaknesses. Complex subsurface geology can be characterized using surface-geophysical methods. Successful characterization of levee materials and subsurface geology has been accomplished using capacitively coupled and direct-current resistivity data. Listed below are two sample USGS reports where surface geophysics was applied to characterize levee materials. Other reports are listed on the powerpoint contained on the data CD.



http://pubs.usgs.gov/ds/640/



http://pubs.usgs.gov/of/2011/1211

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USGS
science for a changing world

Capacitively Coupled Resistivity Survey of the Levee Surrounding the Omaha Public Power District Nebraska City Power Plant, June 2011

By Bethany L. Burton and James C. Cannia

Open-File Report 2011–1211

U.S. Department of the Interior
U.S. Geological Survey

INCLUDED ON DATA CD

Many Agencies … One Solution … Reducing Risk
The Silver Jackets Program

The U.S. Army Corps of Engineers is collaborating with the Federal Emergency Management Agency and other federal agencies to create interagency teams that engage with a state to develop and implement solutions to a state's natural disaster priorities.

The primary goals of the Silver Jackets program, created in April 2005, are to leverage information and resources, identify gaps between agency programs, improve public flood risk communication through a united effort with coordinated interagency messages, and to create a mechanism to collaboratively solve issues and implement initiatives.

The Silver Jackets approach, which so far has focused on flood mitigation programs, is built on not duplicating existing similar efforts but rather on supplementing, strengthening and establishing relationships where they don't exist. Each state team is expected to be different.

To date, Silver Jackets has initiated pilot programs in Ohio, Indiana and California. These teams have succeeded not only in improving communication, but also in leveraging resources and programs between federal agencies.

No single agency has the 100 percent solution -- each has one or more pieces, similar to squares in a patchwork quilt. The Silver Jackets program can be viewed as a quilting bee, the place where all the agencies and the state come together to put their squares together.

For example, coordination through the Ohio team has enabled the community of Marietta to acquire detailed mapping of its community at nominal cost by tapping into an ongoing regional watershed study. Through the same Silver Jackets team, an opportunity was discovered to integrate two different programs by using the USACE Planning Assistance to States program to provide resources and FEMA's Flood Mitigation Assistance program to outline the requirements – resulting in the town gaining eligibility for FEMA flood mitigation funds.

Plans are to establish a Silver Jackets team in at least one state in every Corps division across the United States in the next fiscal year. The program is continuing team development on a state-by-state basis, ultimately establishing an interagency team in every state.

A brochure about the Silver Jackets program is available at:
http://www.iwr.usace.army.mil/nfrmp/docs/Silver_Jackets_Tri-fold_1-9-09.pdf

NEBRASKA SILVER JACKETS

Many Agencies One Solution

Flood Risk Communication WebTool

http://floods.dnr.ne.gov

Authorities and programs to address flood risk and floodplain management are housed within a number of federal and state agencies; no single federal or state agency has all the answers. Accordingly, public communication on flood risk and floodplain management is dispersed throughout multiple agencies.

This webtool provides a collaborative approach amongst agencies to present information from multiple agencies in a more comprehensive format. Two series of pages have been developed:

Flood Risk *http://floods.dnr.ne.gov/riskmanagement.html*

Objective: Assist homeowners in making
RISK INFORMED DECISIONS.

-Am I at risk of flooding?
-What type of flooding am I exposed to?

→

-What is the probability?
-What is the consequence?
-How will my current mitigation perform?

→

-How can I mitigate my risk?

Flood Response *http://floods.dnr.ne.gov/flooding.html*

Objective: Assist homeowners in
UNDERSTANDING, **RESPONDING** to, and **REBUILDING** after a flood.

Before a Flood → During a Flood → After a Flood