Dam Repairs and Hiring an Engineer
Meeting Logistics

• All lines are muted
• We will have several Q&A breaks
• Can ask a question at any time using the Question box.
• At the end, if there is time, we may open up for audio questions.
• Meeting is being recorded and can be watched at a later time.
• Meeting slides and other resources are available for download in handout section.
  – Handout with links to other resources
  – When a permit is needed
  – How to apply for a permit
  – Dam Maintenance Manual
  – Copy of today’s powerpoint slides
Webinar Series

• **May 6: Dams 101 and DNR Dam Safety Program**
  – Learn about how dams work, what are the critical parts and features, and how they are regulated in Iowa.

• **May 13: How Dams Fail and How to Properly Maintain Your Dam.**
  – Learn about common ways that dams fail and how proper maintenance can reduce the risk of failure.

• **May 20: Dam Ownership, When and How to Hire an Engineer**
  – When do you need to call in an expert? We’ll discuss when and how to find and hire qualified engineers to help with repairs and design of dams.

• **May 27: Dam Design and Permitting**
  – This webinar will go into technical engineering design requirements and what’s needed to obtain a permit. We will also discuss upcoming changes to Iowa’s dam safety administrative rules.
Introductions: DNR

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Introductions: NRCS

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Presentation Outline

- When is an engineer needed
- NRCS Services
- Finding a qualified engineer
- Contracting and Design process
- Rehabilitation timelines
- Typical dam repair costs
- Examples
Recap of previous webinars

• Large number of dams in Iowa
  – Small to large
• Dams serve many purposes
• Dams can fail and cause downstream damages if not properly constructed and maintained
• The DNR dam safety program regulates dams in Iowa to reduce that risk of failure
Typical problems that require an engineer

- Inadequate discharge or storage capacity
  - Could be due to hazard classification changes
- Severe spillway deterioration
  - Rusted through pipes
  - Concrete spillway deterioration
- Embankment Slope Failure
- Severe erosion
  - Wave erosion at water level
  - Downstream slope excessive erosion
- Excessive seepage
- Sink holes, cracks, unusual depressions.
- Need to install a drain.
DNR Review Required

- If the dam meets the thresholds for DNR regulation:
  - Modification or alteration of any dam or appurtenant structure beyond the scope of ordinary maintenance or repair.
  - Any changes from previously approved plans.
  - Should contact DNR for any significant repairs.
Examples: Inadequate spillway capacity
Examples: Spillway Deterioration
Examples: Slope failures
Examples: Seepage
Examples: Depressions, Sinkholes, and Cracks
Dam Rehab Funding: The Need

- Per ASDSO 2019 update of the “The Cost of Rehabilitating Our Nation’s Dams”

<table>
<thead>
<tr>
<th>Ownership</th>
<th>No of Dams</th>
<th>Cost of Rehab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Federal</td>
<td>87,640</td>
<td>$65.89 Billion</td>
</tr>
<tr>
<td>Non Federal High Hazard</td>
<td>14,343</td>
<td>$20.42 Billion</td>
</tr>
<tr>
<td>Federal</td>
<td>3,828</td>
<td>$4.78 Billion</td>
</tr>
<tr>
<td>Federal High Hazard</td>
<td>1,286</td>
<td>$3.35 Billion</td>
</tr>
</tbody>
</table>
## Typical Dam Repair Costs

Total national need for dam safety rehabilitation (2009 values)

<table>
<thead>
<tr>
<th>Dam Height</th>
<th>Cost Estimate</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 – less than or equal to 15 feet</td>
<td>$276,098/dam</td>
<td>$2.273 billion</td>
</tr>
<tr>
<td>Group 2 – 16 to 25 feet</td>
<td>$649,821/dam</td>
<td>$8.130 billion</td>
</tr>
<tr>
<td>Group 3 – 26 to 50 feet</td>
<td>$1,685,834/dam</td>
<td>$22.569 billion</td>
</tr>
<tr>
<td>Group 4 – greater than 50 feet</td>
<td>$8,851,025/dam</td>
<td>$18.485 billion</td>
</tr>
</tbody>
</table>
Natural Resources Conservation Service

Mark McCurdy will present on overview of services provided.
Hiring Consultants
The Process of Getting the Job Done

• Step 1: Meet with potential consultants and receive proposals (three recommended)
  – Should include detailed scope of work and fee breakdown
• Step 2: Pick consultant (contracting)
• Step 3: Consultant begins design process
  – Surveying
  – Geotechnical Investigations
  – Preliminary Plans and Review of Plans
  – Initial Permitting discussions with DNR
  – Final Plans
The Process of Getting the Job Done

- Step 4: Final Permitting (local, state and/or federal)
- Step 5: Consultant gets construction bids (three recommended)
- Step 6: Owner hires contractor upon recommendation of consultant
- Step 7: Construction
How to Find a Qualified Engineer

- Iowa DNR Dam Safety Program can provide some consultants that typically submit dam designs
- Local NRCS office
- Iowa Chapter of American Society of Civil Engineers (ASCE)
- Iowa Engineering Society
- Web searches/phone directories (just a starting point)
Qualities to Look For in Professional Engineers

• Company should have a strong background in civil, agricultural, geotechnical, or water resources engineering
• What is firm’s primary work?
• Should have expertise or partnership with other firms in:
  – Hydrology
  – Hydraulics
  – Geotechnical Engineering
  – Structural Engineering
• Company should be familiar with the Iowa dam safety laws and rules
• Company should have experience in design of dams and hydraulic structures
  – Can the provide recent project examples from current staff of similar dams
• Company must employ engineers that are registered in state in which dam is located
### The Process of Getting the Job Done

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2</td>
</tr>
<tr>
<td>Hire a Consultant</td>
<td></td>
</tr>
<tr>
<td>Surveying</td>
<td>3 4</td>
</tr>
<tr>
<td>Geotechnical</td>
<td>5</td>
</tr>
<tr>
<td>Const. Drawings</td>
<td>6 7</td>
</tr>
<tr>
<td>Permitting</td>
<td>8 9 10</td>
</tr>
<tr>
<td>Hire a Contractor</td>
<td>11 12</td>
</tr>
<tr>
<td>Construction</td>
<td>13 14 15</td>
</tr>
</tbody>
</table>

The table above illustrates the timeline for various tasks involved in getting the job done, with each task and its corresponding months highlighted. For instance, hiring a consultant occurs in the first two months, surveying is scheduled between the third and fourth months, geotechnical work is scheduled in the fifth month, construction drawings span from the sixth to the seventh months, permitting takes place from the eighth to the ninth months, and hiring a contractor occurs in the eleventh and twelfth months. Construction is scheduled from the thirteenth to the eighteenth months.
Typical Dam Repair Costs – Example 1

• Rehabilitation of a typical Group 2 dam (22 feet high)
• Description of repair activity:
  – Replace spillway
  – Raise embankment 6 feet in elevation
  – Replace lake drain
Typical Dam Repair Costs –
Example 1 (Cont.)

- Remove existing spillway lump sum: $12,000
- New fill 14,000 yds @ $8/yd: $112,000
- Re-used fill -- 6,000 yds @ $5/yd: $30,000
- Concrete inlet to culvert 17 yds @$700/yd: $11,900
- Concrete culvert 183 yds @ $700/yd: $128,100
- Concrete stilling basin 36 yds @ $700/yd: $25,200
Typical Dam Repair Costs – Example 1 (Cont.)

- Roadway lump sum: $24,000
- Drain replacement lump sum: $24,000
- Diversion lump sum: $2,400
- Dredging 5,000 yds @ $8/yard: $40,000
- Contingencies and miscellaneous, riprap, and drainage material: $60,000

- Subtotal: $469,600
Typical Dam Repair Costs – Example 1 (Cont.)

- Survey + Subsurface Investigation: $10,200
- Design Engineering + Permitting: $46,300 + $15,000 = $61,300
- Construction Services: $20,000

- Total (including previous subtotal): $617,600
Typical Dam Repair Costs –
Example 2: Overtopping Protection

• Example: Rehabilitation of a typical Group 2 dam: (20’ high, 300’ long, 15’ wide, 2H:1V U/S & D/S Slopes, 30’ long runout apron)

  – Description of repair activity:
    • Design dam to safely overtop to pass the spillway design flood.
Typical Repair Costs: Example 2 - Overtopping Protection

- These dimensions result in 27,000 square foot (3,000 sq. yd.) of surface area to be armored.
# Types of Overtopping Protection and Costs

<table>
<thead>
<tr>
<th>Overtopping</th>
<th>Unit Cost</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller Compacted Concrete (RCC)</td>
<td>$10.00 to $15.00 per sf</td>
<td>Usually produced on-site, so large staging area needed for plant and materials.</td>
</tr>
<tr>
<td>Articulated Concrete Blocks</td>
<td>$11.00 to $15.00 per sf</td>
<td>Lab studies show stable for up to 4 feet of overtopping depth.</td>
</tr>
<tr>
<td>Conventional Cast-in-Place Concrete (reinforced)</td>
<td>$27 to $42 per sf</td>
<td>Difficult to place on 2H:1V slope. Attention must be made to joint placement and details.</td>
</tr>
<tr>
<td>Gabions</td>
<td>$18 to $24 per sf</td>
<td>Baskets are subject to long term corrosion and vandalism. Overtopping depths typically limited to 4 feet or less.</td>
</tr>
</tbody>
</table>
Types of Overtopping Protection and Costs: Examples

Roller Compacted Concrete (RCC)
Types of Overtopping Protection and Costs: Examples

Articulated Concrete Block
Types of Overtopping Protection and Costs: Examples

Cast-In-Place Concrete
Types of Overtopping Protection and Costs: Examples

Gabions
Types of Overtopping Protection and Costs

• For this size dam a total project cost for overtopping protection can range from $300,000 to over $600,000 - at least as much, if not more than a major rehab - and is usually not recommended. It is typically approved only as a last option.
Local Example: Waterford Dam

- Small Development Pond
  - 40 feet high
  - 500 long
  - 53 acre-ft of normal storage
  - 4.5 acre surface area
- Built in 1966
- 30” Corrugated Metal Spillway Pipe
Waterford Dam
Waterford Dam
Waterford Dam
Design Services

• Fee of about $10,000 included:
  – Topographic survey
  – Construction drawings
  – Meetings
  – Construction Staking
• Did not include bidding services, cost estimates, construction observation
  – These would have increased the fee.
Project cost

- Contractor bids were in the range of $220,000
  - 100 CY of excavation
  - 192 feet of new spillway pipe
  - Concrete path replacement
  - Seeding and misc.
During the Project

• Don’t be afraid to ask a lot of questions of YOUR engineer during planning & design.

• During construction:
  – Ensure that your engineer implements a thorough construction inspection program that includes input from the design engineer
  – Construction oversight of critical phases of construction
During the Project

• Examples of Critical Phases of Construction:
  – Foundation Preparation
  – Outlet Works Construction
  – Testing of Materials (e.g. concrete testing, placement and compaction of soils)
  – Internal Drainage
During the Project

• During construction:
  – Take many pictures
  – Document conversations with the engineer and contractor
Funding

- Iowa DNR dam safety does not currently have any dam rehabilitation loan or grant programs (except for low head dam mitigation)
- FEMA disaster mitigation funding (publicly owned dams)
- FEMA High Hazard Potential Dam Grant Program
  - $10 million national
  - Publicly owned dams
  - 35% match
  - Many stipulations
- Natural Resources Conservation Service
  - May have rehabilitation funding if designed by NRCS or SCS.
Other Options for Dealing with Rehab Issues $$$$

- Phased repair program
- Transfer ownership
- Dam removal
- Decrease size of dam and impoundment - A smaller dam will decrease the downstream damage potential and may change the regulatory requirements
Final Questions
Additional Resources

- Association of State Dam Safety Officials
  - Membership open to all dam owners, consultants, and dam safety officials
  - Many available resources both for members and general public
    - [http://damowner.org/](http://damowner.org/)
    - [http://damfailures.org/](http://damfailures.org/)
    - [http://damsafety.org/](http://damsafety.org/)

- Low Head Dams
  - Concrete or rock dams across a river or stream channel.
  - DNR Water Trails staff works with low head dam owners to improve safety around dams.
    - [https://www.iowadnr.gov/Things-to-Do/Canoeing-Kayaking/Low-Head-Dams](https://www.iowadnr.gov/Things-to-Do/Canoeing-Kayaking/Low-Head-Dams)

- Iowa Ponds Website
  - DNR fisheries biologist recommendations
    - [https://www.iowadnr.gov/Fishing/About-Fishing-in-Iowa/Iowa-Ponds](https://www.iowadnr.gov/Fishing/About-Fishing-in-Iowa/Iowa-Ponds)
Upcoming Webinars

• May 27: Dam Design and Permitting
  – This webinar will go into technical engineering design requirements and what’s needed to obtain a permit. We will also discuss upcoming changes to Iowa’s dam safety administrative rules.

https://www.iowadnr.gov/dams