consulting engineers and scientists

Reischl Dam
Overtopping –
Embankment and
Spillway Restoration
Paul D. Drew, P.E., CFM
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Project Location

Lake Reischl
Reischl Dam
Fox River
Waukesha Co.
Racine Co.
Reischl Dam – October 2012

- Reischl Lake
- Dam Crest (15’ Wide)
- Downstream Slope
• Dam Type: 1,000 LF Earthen Embankment
• Location: Town of Vernon, Waukesha Co.
• Structural Height of Dam: 14.5 feet
• WDNR Classification: Large Dam
• Spillway: 12” drop inlet
• Hazard Rating: Low
  – Minimum Principal Spillway Capacity for $Q_{10}$
  – Minimum Total Spillway Capacity for $Q_{100}$
• Owned and Operated by: Norris Adolescent Center
• Wisconsin Department of Natural Resources (WDNR) performed site inspection.

• Identified the following actions:
  – Hire consultant to inspect condition of dam
  – Prepare Interim Emergency Action Plan (EAP)
  – Prepare Inspection, Operation and Maintenance Plan (IOM)
  – Prepare a Dam Failure Analysis (DFA)
Existing Spillway

Primary 12” Morning Glory Inlet - Spillway
Existing Spillway

Corroded Drop Inlet CMP
Existing Spillway

Primary 12” Morning Glory Inlet - Spillway

Non-Engineered Breach Channel (invert lower than 12” Spillway)

Dam Overtopping
Existing Spillway Outlet

12” Spillway Outlet

Breach Channel

“Riprap”
Existing Spillway Outlet

Pipe Perforations

Pipe Undermining
<table>
<thead>
<tr>
<th>Storm Event</th>
<th>Maximum Pipe Discharge</th>
<th>Maximum Breach Channel Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Year</td>
<td>10%</td>
<td>90% (0.8 feet overtopping)</td>
</tr>
<tr>
<td>100-Year</td>
<td>8%</td>
<td>92% (1.5 feet overtopping)</td>
</tr>
</tbody>
</table>
Existing Spillway Outlet

- Plunge Pool (Scour)
- Downstream of Outlet
- Embankment Toe
- Toe of Dam
- Flow
Existing Embankment

- Embankment covered with trees and woody vegetation
- No ground cover
- Steep Slopes (1.5:1 max, 2:1 min.)
- Non-Engineered Channel at toe of embankment
Summary of Deficiencies

• Phase I inspection of the dam
• Summary Dam Deficiencies from 2011 GEI Inspection:
  – Existing Spillway undersized / corroded and dam is currently overtopping through non-engineered breach channel.
  – Trees and vegetation cover dam crest and downstream slope. Trees can lead to seepage and piping issues / progressive slope failure.
  – Steep downstream slopes with no ground cover. (Does not meet WDNR stability requirements)
GEI Recommendations

• Summary of GEI Recommendations / Design:
  – **Remove Trees** and Woody brush on embankment
  – **Remove Existing Spillway and construct new spillway** in accordance with WDNR Dam Safety Regulations. Move spillway to center of dam embankment inline with downstream tributary
  – **Raise left embankment** to prevent overtopping and provide freeboard during normal pool conditions and 100 year flood events.
  – **Re-grade the downstream** slope with stable slopes per WDNR stability criteria. Re-establish ground cover.
• WDNR / USACE Permitting:
  – All rehabilitation work was designed in accordance with the requirements of NR 333.05 and NR 333.07.
  – **NR 333.05**: Hydraulic, Hydrologic and Stability Analyses
  – **NR 333.07**: Hydraulic design and safety requirements
  – **NR 333 Chapter 140 & 116.07**: Dam Failure Analysis and Inundation Mapping
  – Submitted May 2012, Approved June 2012
• **Waukesha / Racine County:**
  – Waukesha County
    • Floodplain Development
    • Conditional Use (Building Permit)
    • “No Downstream Impacts”
  – Racine County
    • Zoning of DFA
    • Adopt “Low Hazard” Classification
• Waukesha County’s Focus: “Downstream Impact”
  – Increase in Regional Flood Flows
  – Increase in non-flood flows
  – Increase Base Flood Elevation

• WDNR Focus: Dam Safety
  – Increase Existing Spillway Capacity to **Safely** pass at least $Q_{100}$
  – Increase in Spillway Capacity creates negligible rise because of Tailwater from Fox River
  – No residences or buildings would be inundated during existing and proposed condition
  – Operating Lake at same normal WL, same volume of flow, but at higher peak flow rate.

Permitting – Conflicting Regulations?

BFE = 777

Reischl Dam

Fox River
• Ways to achieve “No Downstream Impact” as defined by Waukesha County:
  – Replace Spillway in Kind (Does not Meet WDNR Dam Safety Regulations)
  – Increase Storage Capacity of Lake (Would have to flood the property of Shoreline residents)
  – Operate the Lake at a lower elevation (Shoreline Residents, Town, WDNR objected)
  – Remove the DAM.
• Solution
  – Waukesha County:
    • Agreed that the Dam needed to be restored and not removed.
    • Safety concerns of Dam are primary
  – Racine County
    • Didn’t want to be downstream of a non-compliant Dam.
    • Rather mitigate “downstream impacts” than potential dam failure.
– 4 Month Permitting Process
Embarkment and Spillway Restoration

- Removed Tree Cover and woody brush along 1,000 feet of embankment.
- Stripped 4-6 inches of existing topsoil.
- Tree removal / clearing completed in 2 days.
Embankment and Spillway Restoration

• Removed Corroded CMP
• No lake drawdown was required because of low lake level from dry 2012.
• Existing breach channel to be used as emergency drawdown channel if needed during construction.
• Channel stayed dry during duration of construction.
Embankment and Spillway Restoration

- Drop Inlet (C.I.P.)
- Box Culvert (C.I.P.)
- Baffle Chute (C.I.P.)
- WISDOT Heavy Riprap
- Retaining Wall (C.I.P.)
- New Spillway
- Existing Spillway
- Cofferdam
- Existing Grade
- Filter

SECTION

PLAN
Embankment and Spillway Restoration

- Spillway Type: Cast in Place Drop Inlet.
- Effective Weir Length: Approximately 30 feet.
- Low Level Outlet Capacity: 3 feet – Stop Logs.
- 100-Year Flood Capacity with 1 foot Lake Freeboard.
- Constructed in PZ-22 cofferdam.
- Designed in Accordance with Bureau of Reclamation “Design of Small Dams”.
Embankment and Spillway Restoration

- Box Culvert: 6’ Wide x 5’ High 16’ Long
- Cast in place concrete headwall
- Discharges to cast in place concrete baffle chute.
- Hand Railings
- Dam Warning Sign
Embankment and Spillway Restoration

- Stable Embankment w/Ground Cover
- Headwall
- Culvert
- WIS DOT RIPRAP (Installed Spring 2013)
- Baffles
Embankment and Spillway Restoration

- Removed woody vegetation from US slope.
- Placed WISDOT “Medium Riprap” below normal WL.
Embankment and Spillway Restoration

- Existing embankment fill consists of a mixture of silty sand (SM), sandy clay (CL) and silty clay (CL).
- The new embankment fill consists of low plasticity clayey material and have a USCS classification of CL, CL-ML or SC.
- Re-graded embankment to meet WDNR stability requirements and establish ground cover.
Embankment and Spillway Restoration

- Removed existing CMP and backfilled excavation and breach channel with new embankment fill.
- Raised left embankment approximately 2 feet.
- Provided 1 foot of lake freeboard during the 100-year flood event.
Acknowledgements

- **Owner**: Don Harris – Norris Adolescent Center
- **GEI Staff**:
  - Rick Anderson, P.E. – Senior Consultant
  - Matt Emrick, P.E. – Project Manager
  - Paul Drew, P.E., CFM – Project Engineer
- **WDNR Staff**:
  - Bill Sturtevant, P.E.
  - Michelle Hase, P.E.
- **Waukesha County**:
  - Amy Barrows
- **Contractor**: Staab Construction
- **Surveyor**: Oneida Total Integrated Enterprises (OTIE)
Questions?

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