Lake Springfield’s Spaulding Dam

How does it work? What if it doesn’t?

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Introduction and Background

Lake Springfield
- Location: Springfield, IL
- Owned by City of Springfield
- Built in early 1930's
- 4,200 acres at normal pool
- Purpose
  - Cooling water for power generation station
  - Community water supply
  - Recreation
Introduction and Background

Spaulding Dam

- Earth Filled Dam 1,600 ft long
- Gated Spillway (5 gates) 265 ft long
- Public Roadway on dam
- Historic Bridge over spillway
- Roadway Bridge over downstream spillway slab
- Class I high-hazard potential
Previous Gates – Floating Drum Gates

- Five spillway gates
- Circa 1932 construction
- 45 ft long by 8 ft high
- Sealed steel drum gates
- Floats on water within float chamber in gate bay
- Inlet/Outlet piping control water level in float chamber
- No mechanical gate lifting equipment
Floating Drum Gate
Replacement Gate Alternatives

- Alt 1a – Hinged Crest Gate – Operators Below
- Alt 1b – Hinged Crest Gate – Operators Above (Two locations Alt 1b1 and Alt 1b2)
- Alt 1c – Hinged Crest Gate – Bascule Type
- Alt 2 – Vertical Lift Gate
- Alt 3 – Pneumatically-Operated, Hinged-Leaf Gate
- Alt 4 – Rehabilitate Existing Gates
# Scoring Matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weighting Factor</th>
<th>Alternative 1A</th>
<th>Alternative 1B</th>
<th>Alternative 1C</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
<th>Alternative 4</th>
<th>Alternative 5</th>
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<tbody>
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<td>Raw</td>
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<tr>
<td>1. First Cost</td>
<td>2.5</td>
<td>3</td>
<td>7.5</td>
<td>3</td>
<td>7.5</td>
<td>2.5</td>
<td>6.25</td>
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<tr>
<td>2. Fail safe, If they fail, loss of lake level will not be an immediate issue</td>
<td>2.5</td>
<td>4</td>
<td>10</td>
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<td>3.5</td>
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<td>3. Independent of existing drain piping for operation</td>
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<td>4. Ability to be remotely controlled and operated</td>
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<td>5. Future maintenance</td>
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<td>3</td>
<td>4.5</td>
<td>4</td>
<td>6</td>
<td>4</td>
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<td>6. Hydraulic efficiency and fine water control</td>
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<td>8</td>
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<td>4</td>
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<td>7. Sediment/debris accumulation</td>
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<td>6</td>
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<td>6.75</td>
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<td>8. Aesthetics and Historic Preservation Concerns</td>
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<td>9. Constructability</td>
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<td>10. Reliability</td>
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<td>7.5</td>
<td>3</td>
<td>7.5</td>
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<tr>
<td><strong>TOTAL WITH FIRST COST</strong></td>
<td><strong>65.5</strong></td>
<td><strong>64.25</strong></td>
<td><strong>61.25</strong></td>
<td><strong>56</strong></td>
<td><strong>65.5</strong></td>
<td><strong>64.75</strong></td>
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<tr>
<td><strong>TOTAL WITHOUT FIRST COST</strong></td>
<td><strong>58</strong></td>
<td><strong>56.75</strong></td>
<td><strong>55</strong></td>
<td><strong>51</strong></td>
<td><strong>55.5</strong></td>
<td><strong>54.75</strong></td>
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New Hinged Crest Gates
Design Development

- Limit concrete demolition and replace one gate at a time
- Permitting authorities
  - IHPA, USACE, IEPA, IDNR
- Limit visual changes to structure and maintain a "historic time capsule"
- Update Emergency Action Plan
Base and Alternate Bids

**DEMOlITION - DOWNSTREAM ELEVATION**
Awarded Contract

• Base Bid + Alternate Bids 1 through 3 - $5.4M

• General Contractor: J.F. Brennan Marine Professionals, LaCrosse, Wisconsin

• Subcontractors:
  • Gate Supplier: Rodney Hunt Company, Orange, Massachusetts
  • Sitework: Vancil Contracting, Springfield, Illinois
  • Electrical: Anderson Electric, Springfield, Illinois
  • Hydraulic Piping and Setup: Sarco Hydraulics, Litchfield, Illinois
  • Concrete Cutting and Coring: Minneapolis Concrete Sawing, Minneapolis, Minnesota
  • Asbestos Abatement: Midwest Asbestos Abatement, Chicago, Illinois
Bulkhead, Dewatering, and Demolition
Drum Gate

Cast, Embedded Side Seal Plate

1930's Construction Techniques

Float Chamber
H Piles

Aligned

then

Held

in

Place

with

Continuous

Channel
“What’s the big deal? We’ve picked up chains heavier than this!”
Mechanical Systems

- Hydraulic Power Unit centrally located in Vault 3
- Access Hatch
- Upper and Lower Vaults
- Coordination and Layout Drawings by Contractor
Schematic Routing of Hydraulic Supply and Return Lines
Concrete Placement

- Facing Concrete
- Float Chamber
- In-filling (Mass Concrete)
- Capping Concrete
- Wet Curing
- Access Trench
- HPiles Support
- Hinges
Redundant Gate Support
Routing Hydraulic Lines

- Hydraulic Line to Far Dogging Device
- Far Cylinder Hydraulic Supply
- Near Cylinder Hydraulic Supply
- Near Cylinder Hydraulic Return
- Provide Sleeves thru Wall at all Conduit Locations
- 3/8" I.D. PCV Drain at Trench Low Points (Typical)

PIPE TRENCH DETAIL
Commissioning and Training
What if it doesn’t work?

- Do Dams Fail?
- What is an EAP & why is one needed?
- How do we alert the public?
- How do we quantify the risks?
- How can modern technology help?
Dams Do Fail

_Hartwick Dam - Lake Delhi, Iowa_

Hartwick Dam failed on July 24, 2010, due to a period of about 10 in. of rainfall in 12-hours. River levels upstream of the dam had reached 10 ft above flood stage prior to the failure.

Maquoketa River
Why do you need an EAP?

- Emergency Planning
- Resource Allocation
- Evacuation
Inundation Mapping
Study Watershed
> 5,000 sq. miles
Reach to be modeled extracted from Hydrography
Digital Soils Data – Hydrologic Soils Group
Digital Land Cover/Land Use Data
Digital Soils/Land Data to Composite SCS Curve Numbers
Build HEC-HMS Hydrology model
Building a Dam Breach Model using HEC-RAS
Lake Springfield’s Dams

- Lake area 4200 acres.
- Watershed 265 sq miles.
- 57 Miles of Shoreline.
- 735 Residences.
- Service territory is more than 160,000 people.
Reaches (Rivers to be modeled)
Cross-Sections
Stream Crossings
All Layers are Complete – Ready to Export to HEC-RAS
HEC-RAS Model - schematic
Cross-Sections based on LiDAR (Light Detection And Ranging)
Dam Breach Model Results
Need Inundation Maps to Identify Hazard Areas
Flood Depth
Inundation Area
Dam Breach Impact Area
Inundation Area on USGS Topographic Map
Inundation Area on Orthophoto
Identify Structures at Risk
Communities at Risk
Add User Valued Information