Dam Decommissioning and Removal

Challenges and Opportunities for Aging Infrastructure

National Stream Restoration Conference

Nashville, TN

August 2, 2022

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Topics to Cover

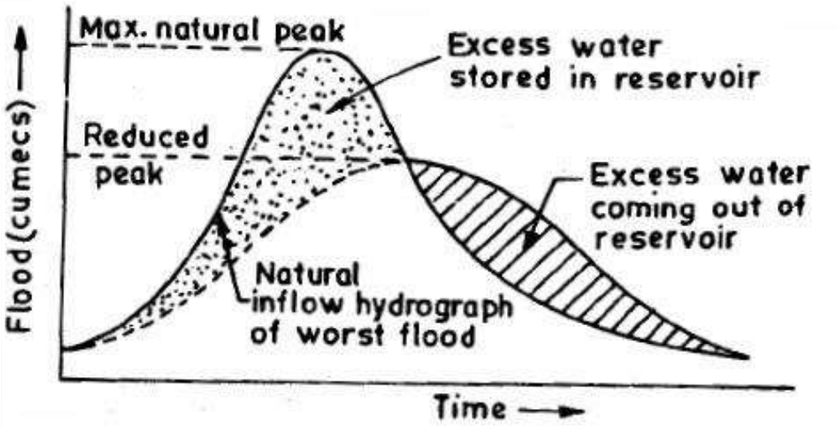
- Why Dam Removal?
- Why Not Dam Removal?
- Example Dam Removal Projects
- Keys to Success

Why Dam Removal?

- Ecological Considerations Drive Most Removal Efforts
  - Temperature
  - Fish Passage
  - Sediment and Nutrient Transport
- Dam Safety
- Decommissioning/Purpose
- Maintenance/Upgrade Costs
- Recreation

Why NOT Dam Removal?

- Environmental Considerations
  - Contaminated Sediment Costs
- Recreation
- Navigation
- Flood Control
- Power Production
- Water Supply



Projects

Alcott Dam Removal

- Low head dam (15’) with impoundment completely full of sediment used engineered riffles and step pools to build river on impounded sediments.

Boardman River Dams

- 60’ high dam featured siphon system to lower impoundment water level and breach dam with low risk to downstream.

Sam Clemente Dam

- An arch dam on the Carmel River about 15 mi southeast of Monterey, CA. Completed in 1921 to supply water to the Monterey Peninsula, the dam was removed in 2015.

Kalamazoo River Dams

- Dams impounded contaminated sediment which required significant consideration in engineering design in relation to influence on construction costs.

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Keys to Success: Social

Social:

Many concerns. Some can be addressed by engineers/scientist. Flooding!

Ecological:

For long term benefit, must get this right!

Care of Water/Dam Safety:

Critical for near term safety. Approach should be consistent with risks.

Sediment Management:

Critical for aquatic life, construction cost and management

Managing Risks and Expectations:

Identifying risks during design is critical to project success

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Social Aspects

Potential Issues

- Property Ownership Issues
- Historical vs. Historic?
- Recreation
  - Lake vs. River
  - Angler concerns
  - Public use
- Fears/Misconceptions
  - Flooding
  - Truck Traffic

Social Aspects: Communicate changes visually

CONCEPTUAL DESIGN RENDERING OF RELOCATED CASS ROAD CROSSING OVER THE BOARDMAN RIVER

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Social Aspects

Social Aspects

CONCEPTUAL DESIGN RENDERING OF RELOCATED CASS ROAD CROSSING OVER THE BOARDMAN RIVER

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Social Aspect Example: Public concern over construction traffic

San Clemente Dam

- **Concern.** During the design-build contractor selection process, public resistance to the construction access route required a major design change to the access location and alignment.
- **Solution.** AECOM quickly completed the required feasibility analysis and design to allow for negotiation of the design-build contract, as well as required permit revisions.
- **Result.** Public concerns alleviated by redesign.

Social Aspect Keys to Success

Keys to Success

- Listen to peoples' concerns
- Communicate using multiple formats
- Share the results of your analysis (conclusions)
- Share the science and engineering (the Why)

Keys to Success: Ecological

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Ecological

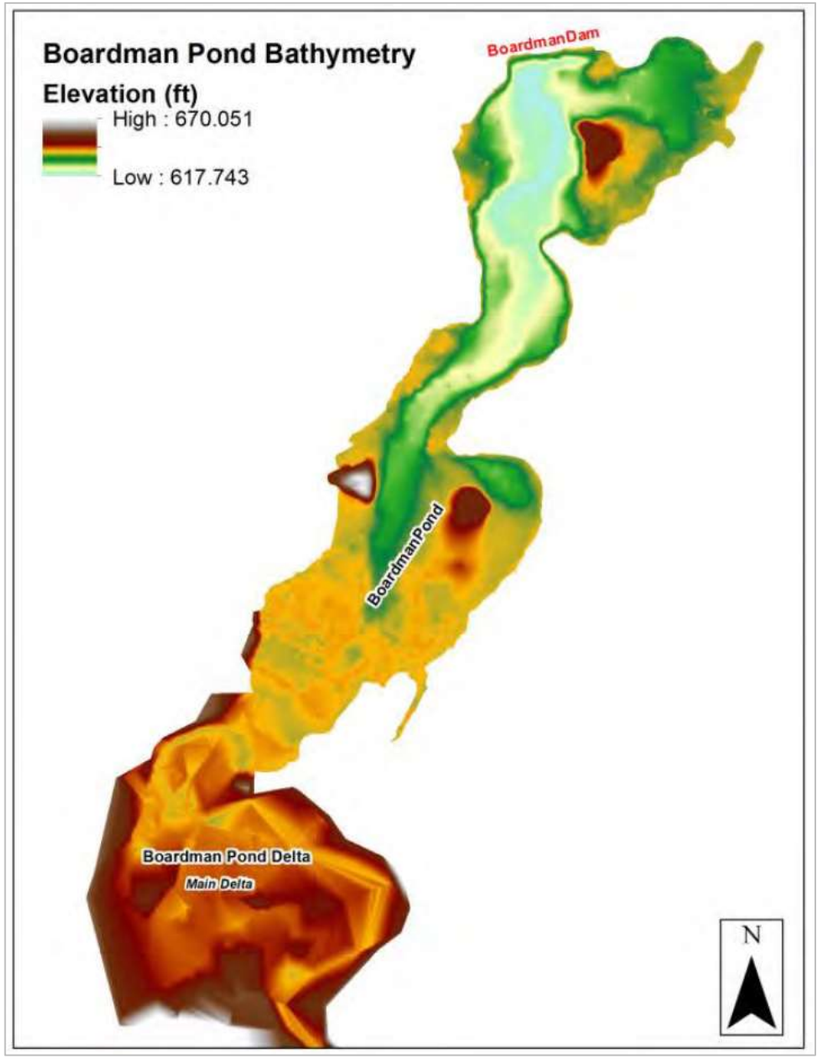
Potential Issues

- Channel/floodplain Characteristics
- Bank Treatments (habitat & stability)
- Revegetation options
- Bi-Directional Fish Passage
  - ✓ Block Invasive Species Passage
  - ✓ Allow Desired Species to Move Up and Down River

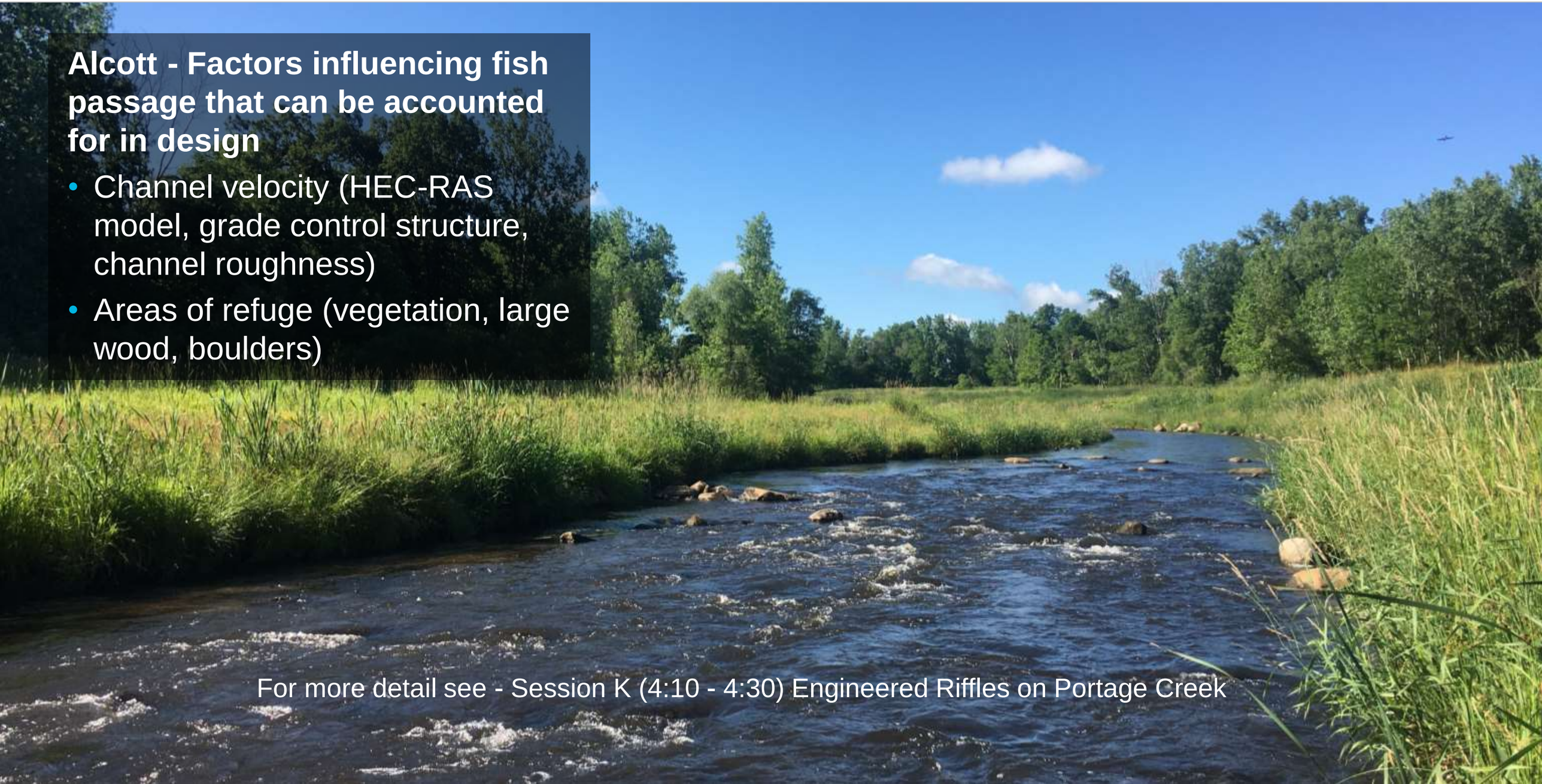
Ecological: Design Approach For River Restoration

Boardman Dam

- Identified pre-dam channel and floodplain using bathymetry, DOR and pre-dam survey/aerials
- Addressed degraded channel sections
  - At dam site
  - Straightened sections
- Check flows and sediment load using modeling tools
- Check channel and floodplain geometry against other approaches



Ecological: Fish Passage



Alcott - Factors influencing fish passage that can be accounted for in design

- Channel velocity (HEC-RAS model, grade control structure, channel roughness)
- Areas of refuge (vegetation, large wood, boulders)

For more detail see - Session K (4:10 - 4:30) Engineered Riffles on Portage Creek

Ecological Keys to Success

Keys to Success

- Longer term horizon to evaluate success; need to manage expectations
- Success may be different for different people
  - Anglers
  - Birders
  - Hikers
  - Bikers
  - Natural resource agencies
  - Regulatory agencies
  - DOT
  - Parks
  - O&M staff
- Make a plan for determining what success looks like
- Implement adaptive management
  - Inspect and correct

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Keys to Success: Care of Water/Dam Safety

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Care of Water and Dam Safety

Evaluate hazards and risks

- Dam Height
- Dam Materials
- Watershed Hydrology
- Upstream/Downstream Impacts

Care of Water and Breaching

- Risk Based Approach
  - Staged dewatering process
  - Cost/Risk Analysis
- Site Specific Solutions Needed
- Integrate with Sediment Management

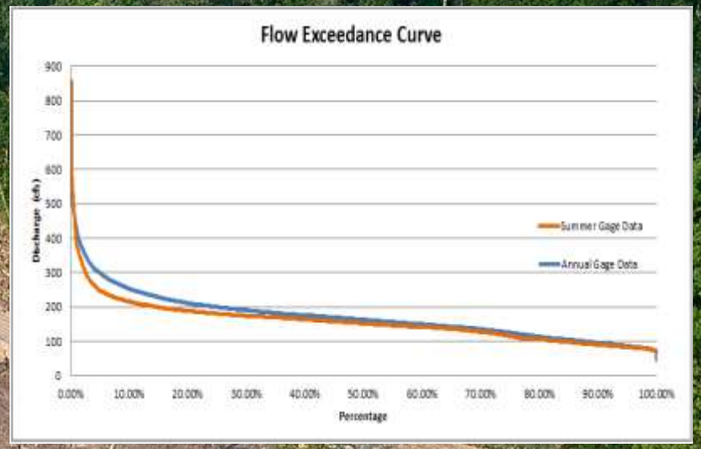
Emergency Preparedness

- EAP

Bypass Siphon System

Auxiliary Spillway

Construction Access



Boardman Dam Dewatering Plan

- ✓ Phased dewatering approach
- ✓ Sediment management within impoundment

Care of Water/Dam Safety Keys to Success

Keys to Success

- Near term time horizon
- Success will go unnoticed by most
- Failure will be recognized by all
- Geotechnical/structural design is important
- Risk related to flows must be considered
- Consider contractor experience and equipment

Keys to Success: Sediment Management

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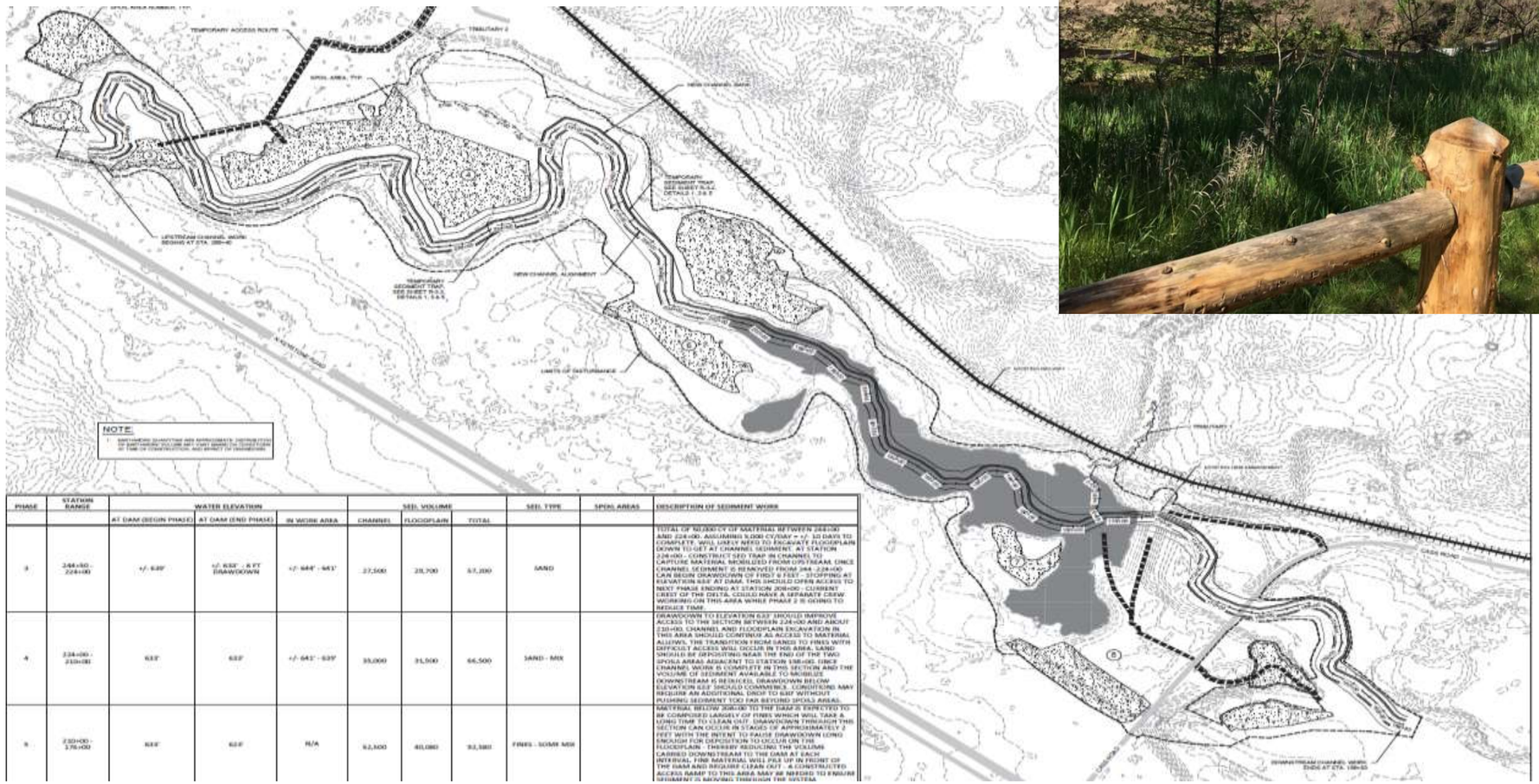
Sediment Management

Potential Issues

- Quantity
- Quality
- Transport (during and after)
- Disposal



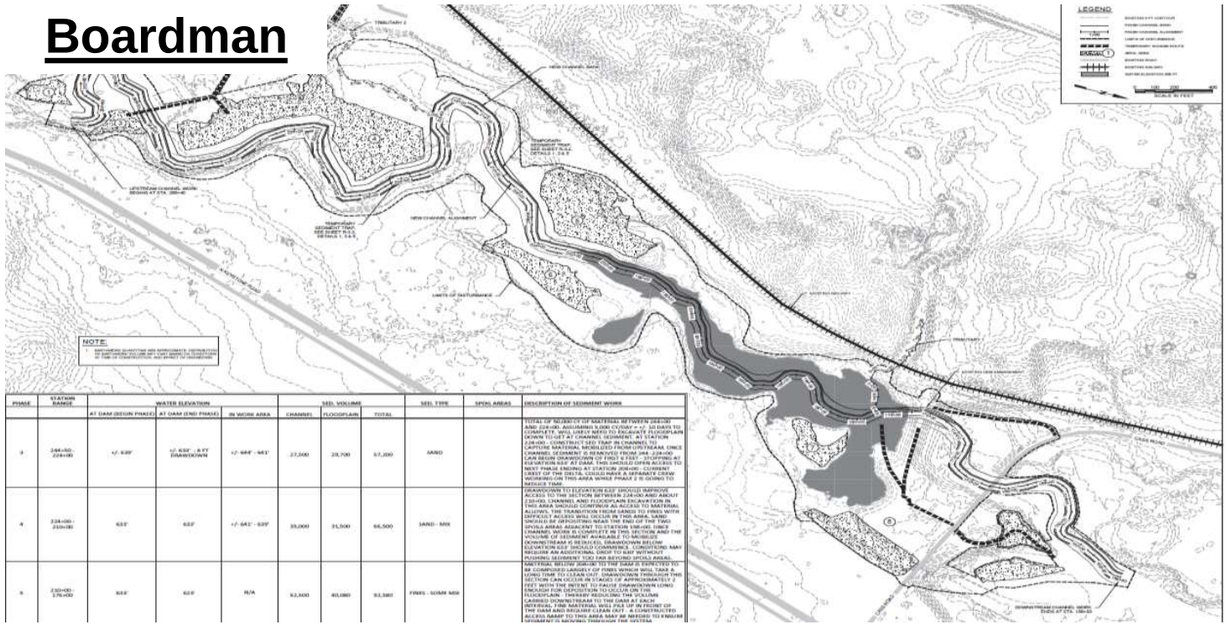
PHASE	STATION RANGE	WATER ELEVATION			SED. VOLUME			SED. TYPE	SPOIL AREAS	DESCRIPTION OF SEDIMENT WORK
		AT DAM (BEGIN PHASE)	AT DAM (END PHASE)	IN WORK AREA	CHANNEL	FLOODPLAIN	TOTAL			
3	244+00 - 224+00	+/- 639'	+/- 633' - 6 FT DRAWDOWN	+/- 644' - 641'	27,500	23,700	51,200	SAND		TOTAL OF 51,200 CY OF MATERIAL BETWEEN 244+00 AND 224+00. ASSUMING 5,000 CY/DAY = +/- 10 DAYS TO COMPLETE. WILL LIKELY NEED TO EXCAVATE FLOODPLAIN DOWN TO GET AT CHANNEL SEDIMENT. AT STATION 224+00 - CONSTRUCT SED TRAP IN CHANNEL TO CAPTURE MATERIAL MOBILIZED FROM UPSTREAM. ONCE CHANNEL SEDIMENT IS REMOVED FROM 244 -224+00 CAN BEGIN DRAWDOWN OF FIRST 6 FEET - STOPPING AT ELEVATION 633' AT DAM. THIS SHOULD OPEN ACCESS TO NEXT PHASE ENDING AT STATION 208+00 - CURRENT CREST OF THE DELTA. COULD HAVE A SEPARATE CREW WORKING ON THIS AREA WHILE PHASE 2 IS GOING TO REDUCE TIME.
4	224+00 - 210+00	633'	633'	+/- 641' - 639'	33,000	31,500	64,500	SAND - MIX		DRAWDOWN TO ELEVATION 633' SHOULD IMPROVE ACCESS TO THE SECTION BETWEEN 224+00 AND ABOUT 210+00. CHANNEL AND FLOODPLAIN EXCAVATION IN THIS AREA SHOULD CONTINUE AS ACCESS TO MATERIAL ALLOWS. THE TRANSITION FROM SANDS TO FINES WITH DIFFICULT ACCESS WILL OCCUR IN THIS AREA. SAND SHOULD BE DEPOSITING NEAR THE END OF THE TWO SPOILS AREAS ADJACENT TO STATION 198+00. ONCE CHANNEL WORK IS COMPLETE IN THIS SECTION AND THE VOLUME OF SEDIMENT AVAILABLE TO MOBILIZE DOWNSTREAM IS REDUCED, DRAWDOWN BELOW ELEVATION 633' SHOULD COMMENCE. CONDITIONS MAY REQUIRE AN ADDITIONAL DROP TO 630' WITHOUT PUSHING SEDIMENT TOO FAR BEYOND SPOILS AREAS.
5	210+00 - 176+00	633'	633'	N/A	32,500	40,080	72,580	FINES - SOME MIX		MATERIAL BELOW 208+00 TO THE DAM IS EXPECTED TO BE COMPOSED LARGELY OF FINES WHICH WILL TAKE A LONG TIME TO CLEAN OUT. DRAWDOWN THROUGH THIS SECTION CAN OCCUR IN STAGES OF APPROXIMATELY 2 FEET WITH THE INTENT TO FAVOR DRAWDOWN LONG ENOUGH FOR DEPOSITION TO OCCUR ON THE FLOODPLAIN - THEREBY REDUCING THE VOLUME CARRIED DOWNSTREAM TO THE DAM AT EACH INTERVAL. FINE MATERIAL WILL PILE UP IN FRONT OF THE DAM AND REQUIRE CLEAN OUT - A CONSTRUCTED ACCESS RAMP TO THIS AREA MAY BE NEEDED TO ENSURE SEDIMENT IS MOVING THROUGH THE SYSTEM

Sediment Management

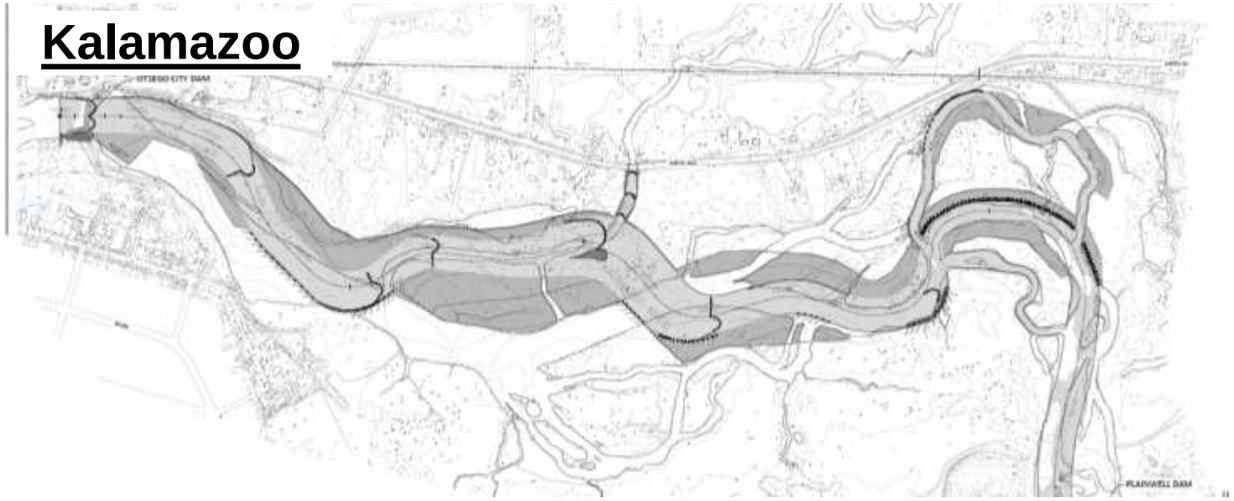
Kalamazoo River Dams vs. Boardman Dam

- Quantity similar quantities (~300K CY)
  - Dam removals typically have large quantities of sediment to manage
  - Ease of management varies with grain size
  - Distance of truck transport impacts cost
- Quality (clean vs. PCB)
  - Huge impact on costs (5X to 10X)
- Sediment Transport (during and after)
  - Consider habitat impacts
  - Consider sediment load versus annual average load
- Disposal (onsite vs. engineered facility)
  - Let some of it go downstream?
  - Out of floodplain
  - Close to where it is in the reservoir
  - Contaminants drive level of containment required

Boardman



Kalamazoo



Sediment Management Keys to Success

Keys to Success

- Costs related to sediment management can be significant and need to be considered by the designer
- Balance sediment storage areas with H&H and geomorphic considerations
- Contaminants pose risk to humans and animals and must be considered

Keys to Success: Managing Risks and Expectations

Social:

Many concerns. Some can be addressed by engineers/scientist. Flooding!

Ecological:

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Managing Risks and Expectations Keys to Success

- Near and longer-term horizon for expectations
- Near-term
  - Construction impacts
  - Turbidity
  - Odor
  - Aesthetics
- Long-term
  - Flooding
  - Aesthetics
  - Terrestrial and aquatic species populations
- Expectations will be different for different people
  - Wild/natural vegetation
  - Manicured and planned park
- Use pictures/renderings to visualize results

Keys to Success

Social:

Many concerns. Some can be addressed by engineers/scientist/historians. Address concerns!

Ecological:

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Dewatering/Dam Safety:

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Thanks for listening