

Applying Effectiveness Monitoring Results to Refine Stream Restoration Design

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Presentation Outline

- ◆ Introduction
- ◆ Stream design methods and structures
- ◆ Project overviews
- ◆ Applying effectiveness monitoring results to improve natural channel designs
- ◆ Summary

Introduction

- Completed three natural channel design projects in Montana
- General project goals:
 - Reduce excessive sediment inputs to streams while allowing channel adjustment over time
 - Maintain vertical channel stability
 - Improve channel-floodplain connectivity
 - Improve fish habitat and riparian condition
 - Minimize construction and maintenance costs

Introduction

- Initiated effectiveness monitoring to assess post-runoff project responses
- Incorporated monitoring results for improving 2002 projects

Stream Design Methods and Structures

- Follow natural channel design principles
 - Provide stream with a naturally stable channel
 - Use native materials to build habitat structures that mimic natural habitat arrays
 - Augment riparian community to improve long-term channel stability and habitat

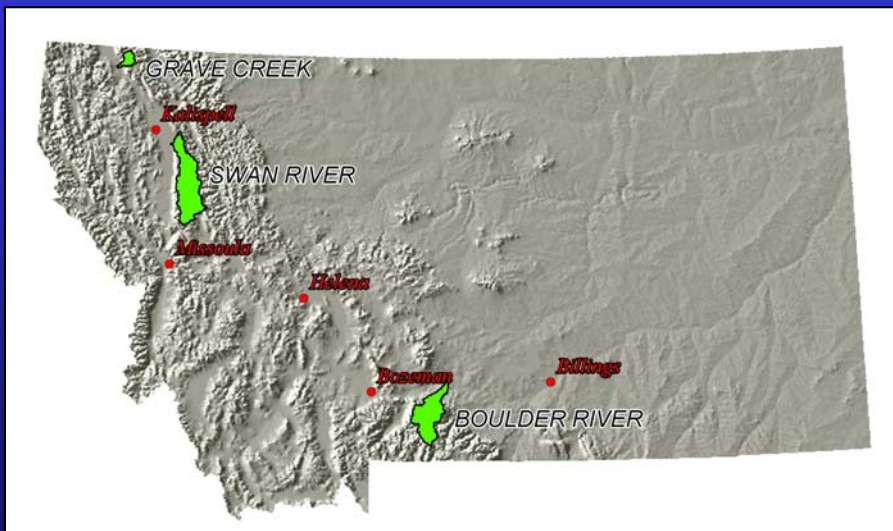
Typical Stream Structures

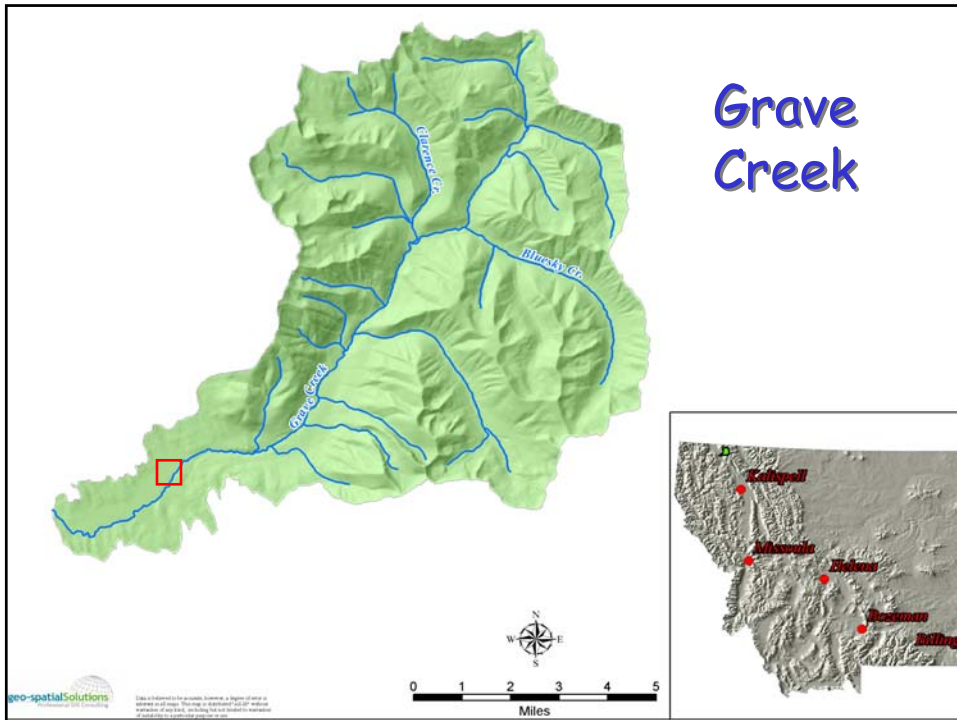


Robert H. Runkle, Ph.D.

Project Overviews

Project Locations





Grave Creek - Baseline Conditions

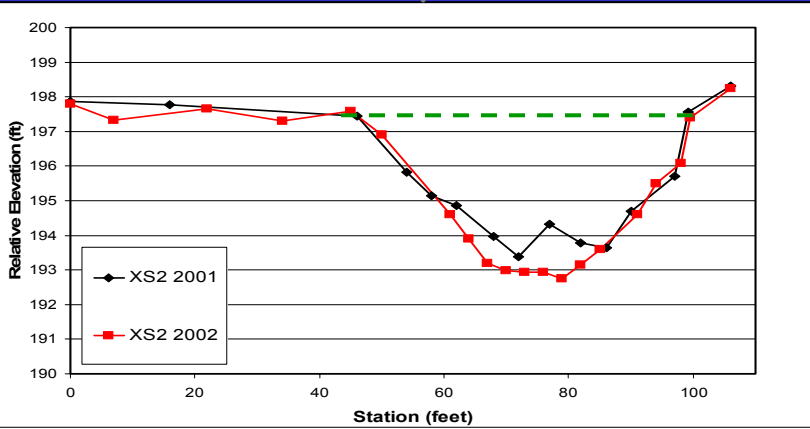
- 1,000-ft reach demonstration project for important bull trout tributary to the Tobacco River
- 650 cfs bankfull discharge
- Baseline conditions
 - Bank and channel instability caused by “maintenance” bull-dozing
 - Overgrazing of riparian zone
 - Accelerated sediment delivery

Grave Creek - Project Design

- ◆ Installed four grade control and multiple bank protection structures
- ◆ Built bankfull bench to buffer eroding terrace during high flows
- ◆ Channel shaping to reduce width/depth
- ◆ Increased pool depths – fish habitat
- ◆ Incorporated woody material
- ◆ Site revegetation

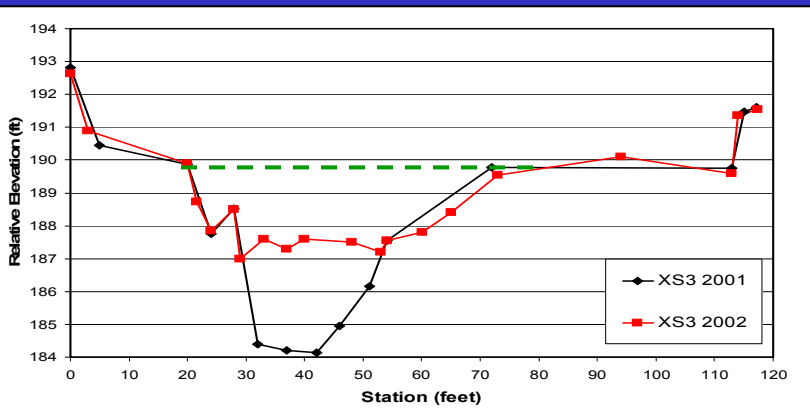


Grave Creek As-Built and First Year Survey Data



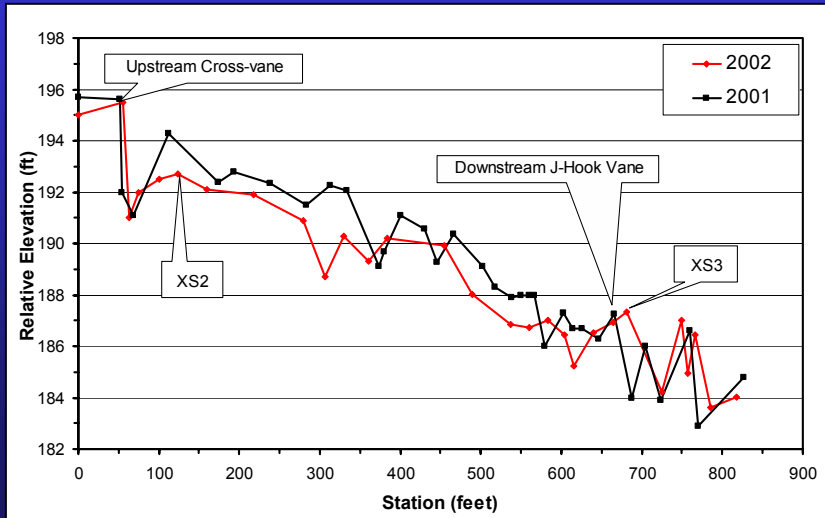
	Width (ft)	Area (ft ²)	Mean Depth (ft)	Max Depth (ft)	W/D
As-Built	53	138	2.6	4.1	20
Year 2002	55	163	3.0	4.8	18

Grave Creek As-Built and First Year Survey Data



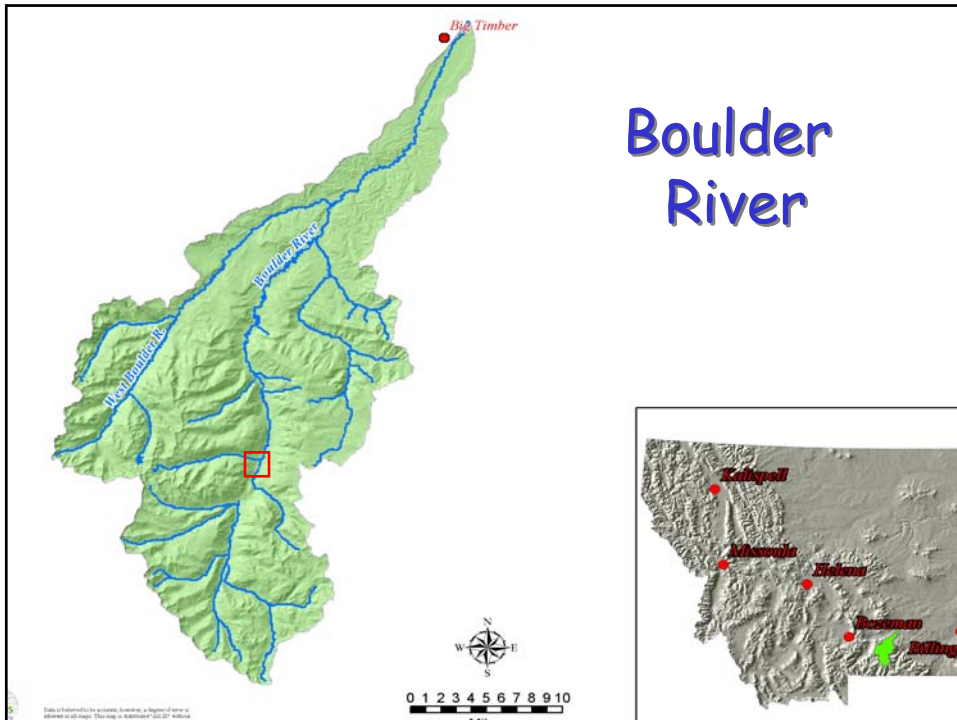
	Width (ft)	Area (ft ²)	Mean Depth (ft)	Max Depth (ft)	W/D
As-Built	52	154	3.0	5.7	18
Year 2002	64	107	1.7	2.9	38

Grave Creek As-Built and First Year Survey Data



Grave Creek Summary

- Project Benefits -
 - Bank erosion reduced as designed
 - Improved fish habitat
 - Long-term channel stability through revegetation effort
- Project Problems -
 - Vertical channel stability issues
 - Sediment transport through some pools

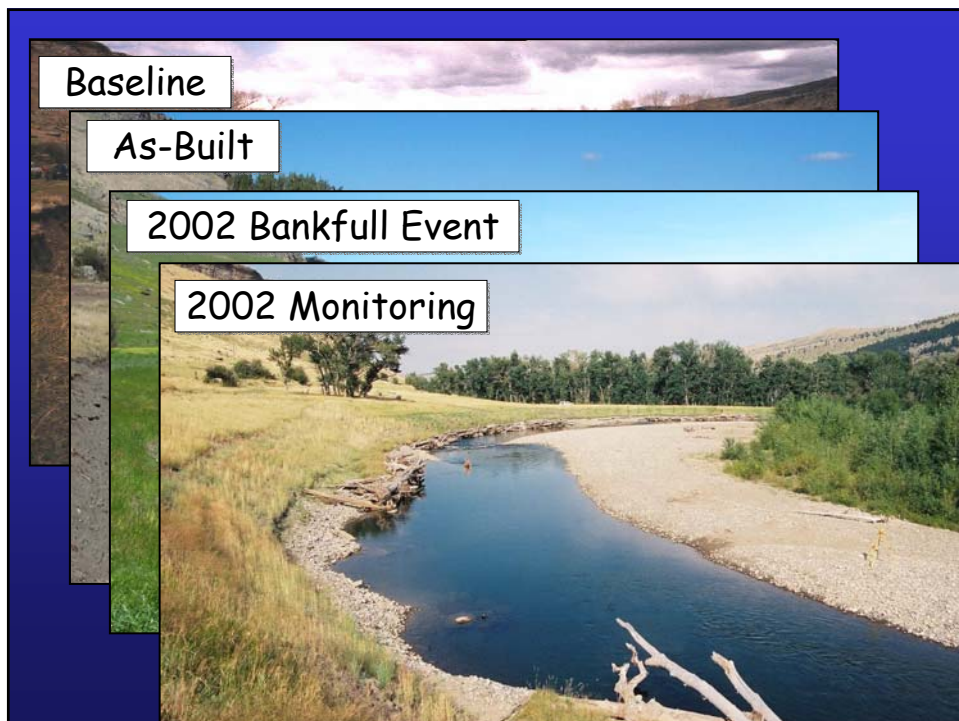


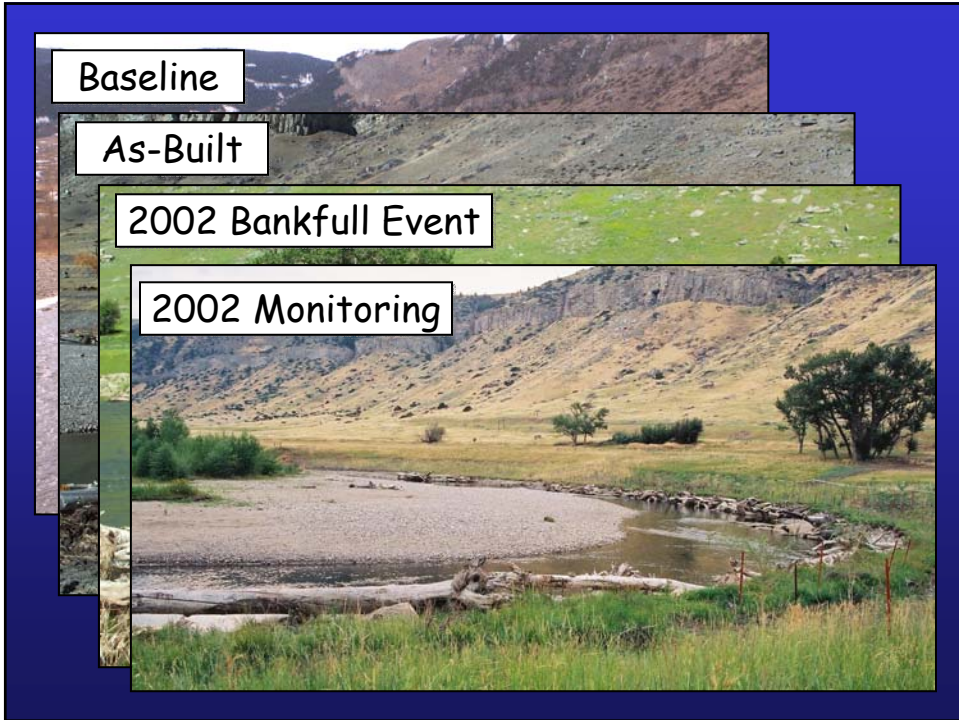
Boulder River - Baseline Conditions

- ◆ Demonstration project for important rainbow and brown trout tributary to the Yellowstone River
- ◆ 3,600 cfs bankfull discharge
- ◆ Baseline conditions
 - Bank and channel instability caused by channel cut-off and berm construction
 - Overgrazing of riparian zone
 - Vertical eroding terrace with accelerated sediment delivery

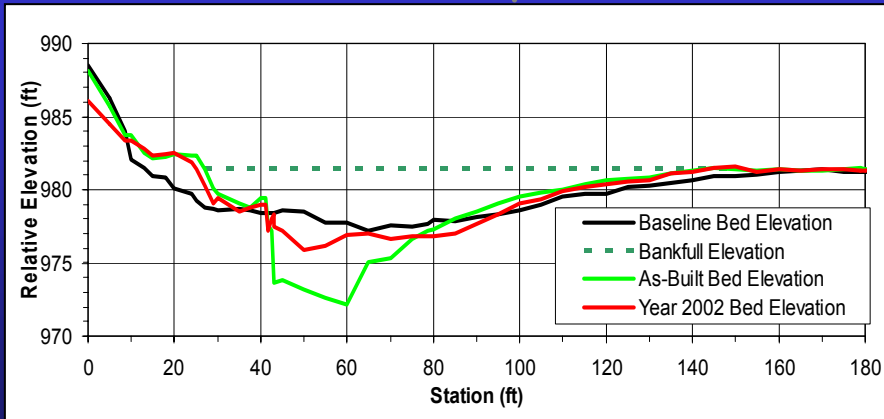
Boulder River - Project Design

- ◆ Installed three grade control and multiple bank protection structures
- ◆ Built bankfull bench to buffer eroding terrace during high flows
- ◆ Channel shaping to reduce width/depth
- ◆ Improve pool complexity – fish habitat
- ◆ Incorporated woody material
- ◆ Site revegetation



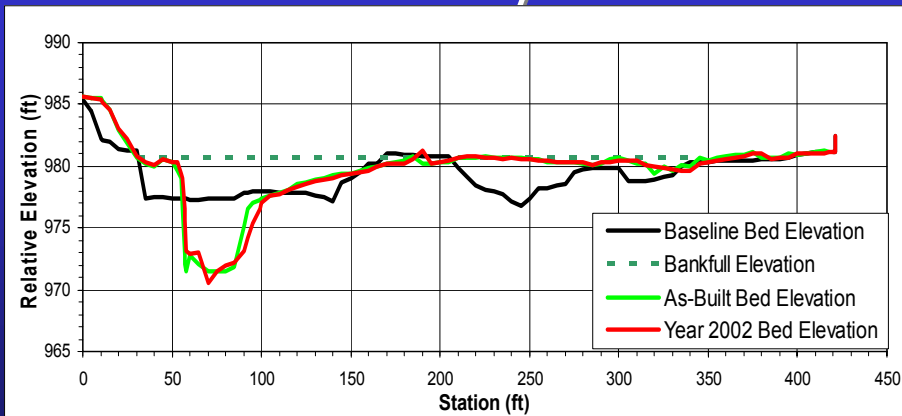


Boulder River As-Built and First Year Survey Data



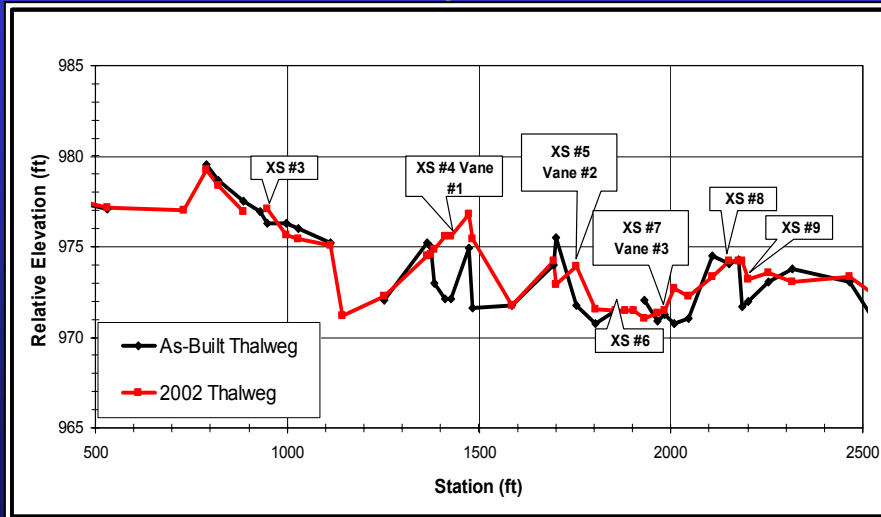
	Width (ft)	Area (ft ²)	Mean Depth (ft)	Max Depth (ft)	W/D
As-Built	120	488	4.1	10.1	30
Year 2002	120	339	2.8	5.5	43

Boulder River As-Built and First Year Survey Data



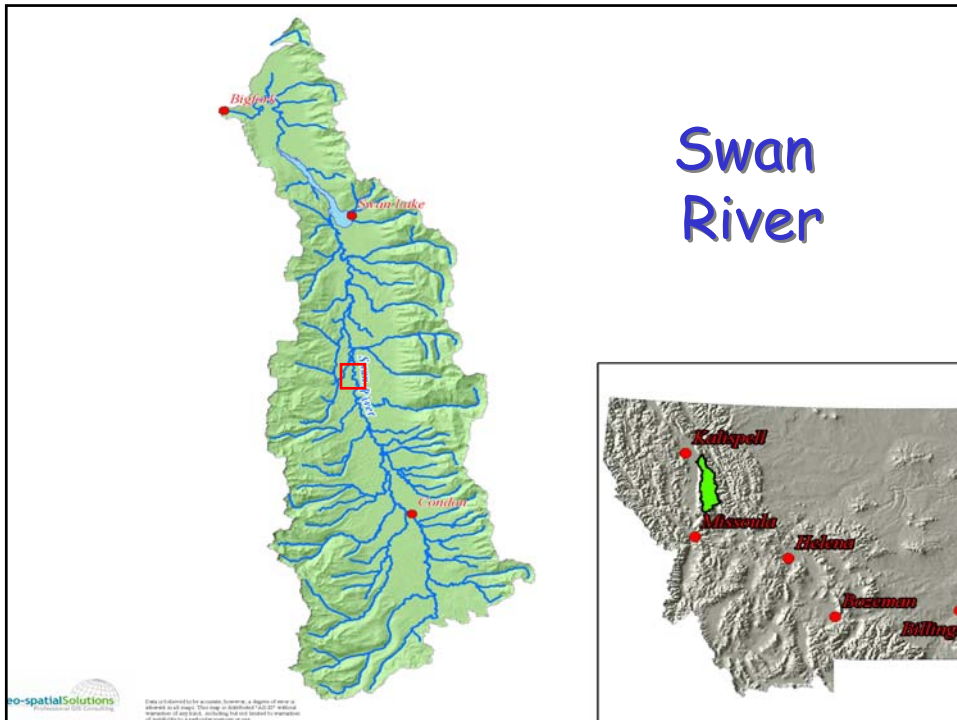
	Width (ft)	Area (ft ²)	Mean Depth (ft)	Max Depth (ft)	W/D
As-Built	155	471	3.0	9.3	51
Year 2002	155	500	5.2	10.2	48

Boulder River As-Built and First Year Survey Data



Boulder River Summary

- 💧 Project Benefits -
 - Terrace erosion reduced as designed
 - Improved fish habitat
 - Long-term channel stability through revegetation effort and channel shaping
- 💧 Project Problems -
 - Vertical channel stability issues
 - Sediment transport through pools
 - Failed bank stabilization structures

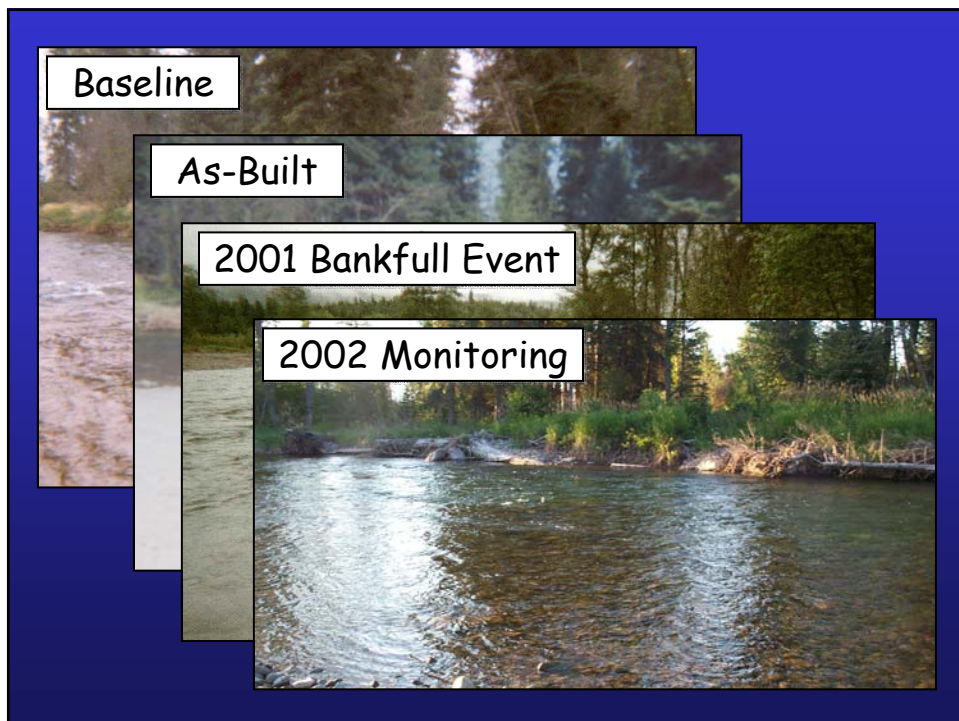


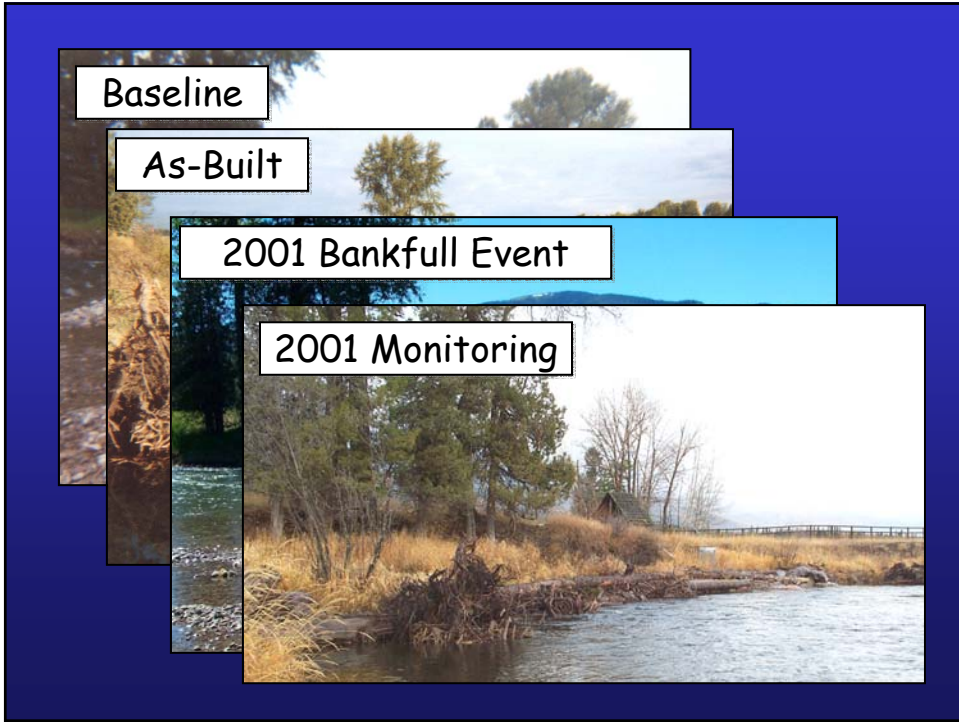
Swan River - Baseline Conditions

- Bull trout stream
- 3,200 cfs bankfull discharge
- Baseline conditions
 - Bank and channel instability believed to be caused by upstream bridge and channel processes
 - Riparian zone conversion
 - Simplified fish habitat

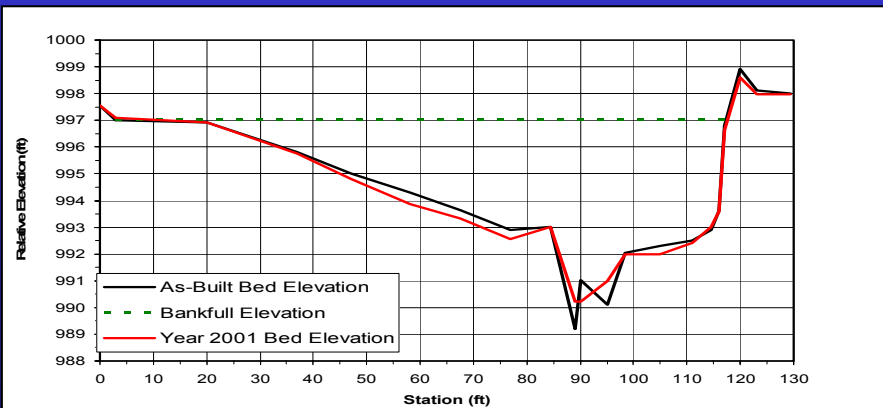
Swan River - Project Design

- ◆ Constructed bankfull bench
- ◆ Placed bank stabilizing rootwads
- ◆ Installed log J-hook vanes for grade control and bank protection
- ◆ Transplanted sod mats and willow clumps
- ◆ Plugged channel avulsion through point bar



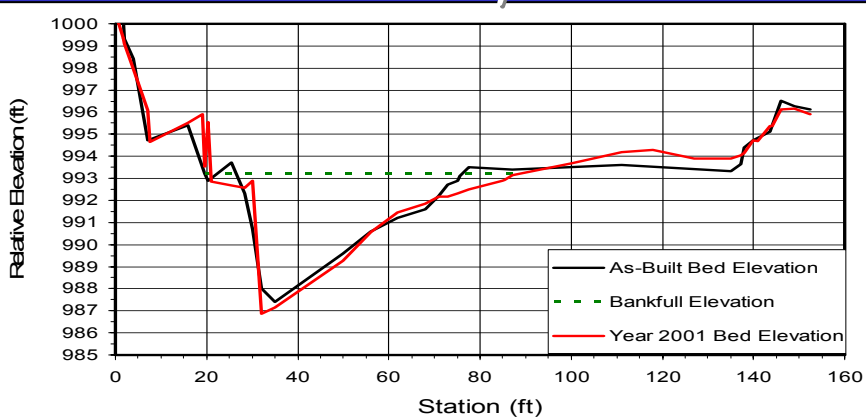


Swan River As-Built and First Year Survey Data



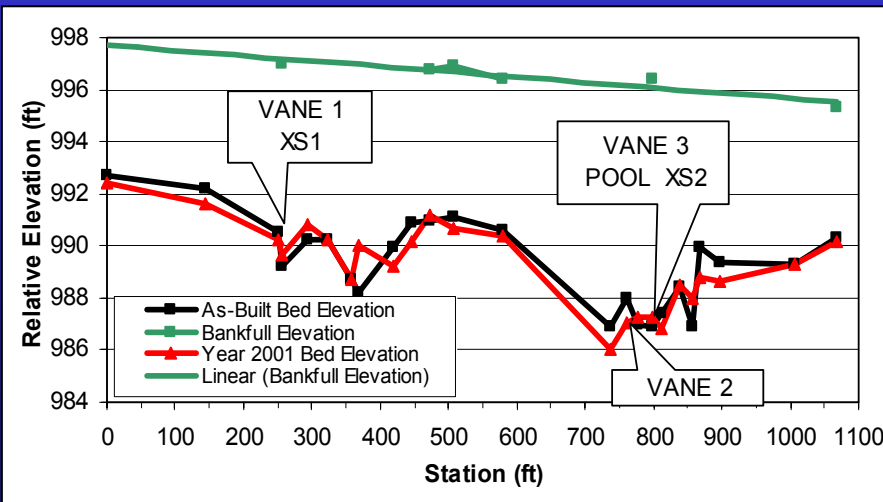
	Width (ft)	Area (ft ²)	Mean Depth (ft)	Max Depth (ft)	W/D
As-Built	114	314	2.8	7.8	41
Year 2002	114	332	2.9	6.9	39

Swan River As-Built and First Year Survey Data



	Width (ft)	Area (ft ²)	Mean Depth (ft)	Max Depth (ft)	W/D
As-Built	58	150	2.6	5.7	23
Year 2002	74.5	183	2.5	6.7	30

Swan River As-Built and First Year Survey Data



Swan River Summary

- Project Benefits -
 - Plugged and revegetated avulsion
 - Improved fish habitat
 - More stable channel plan form
 - Buffered eroding terrace
- Project Problems -
 - Minor bank erosion
 - Continued risk from upstream bridge

Effectiveness Monitoring Results
and Stream Restoration Design

Using Monitoring Data to Improve Restoration Designs

- Effectiveness monitoring critical for identifying project successes and problems
 - Structure response
 - Sediment transport
 - Habitat volume
- Data collection provides important information that photos alone may not capture

Using Monitoring Data to Improve Restoration Designs

- Monitoring should include at a minimum:
 - Permanent cross-section and profiles
 - Pebble counts
 - Photo points
 - Structure elevations
- Additional monitoring could include:
 - Vegetation assessment
 - Fish population/spawning response
 - Monitor treatment and control reaches
- Design techniques should be modified based on monitoring data results

Example Design Modifications

- Pool tailout degradation – cobble patches



Example Design Modifications

- Bank stabilization/habitat – LWD jams



Example Design Modifications

- ◆ Sediment transport and grade control – Structure slopes, elevations, and angles



In Summary

- ◆ Monitoring is pivotal for evaluating restoration techniques
- ◆ On-the-ground experimentation is essential for the evolution of stream restoration practices
- ◆ Sometimes, project problems are more educational than project successes – although they can also be more painful!