Swan River Floodplain Study

A Step Forward in Floodplain Mapping

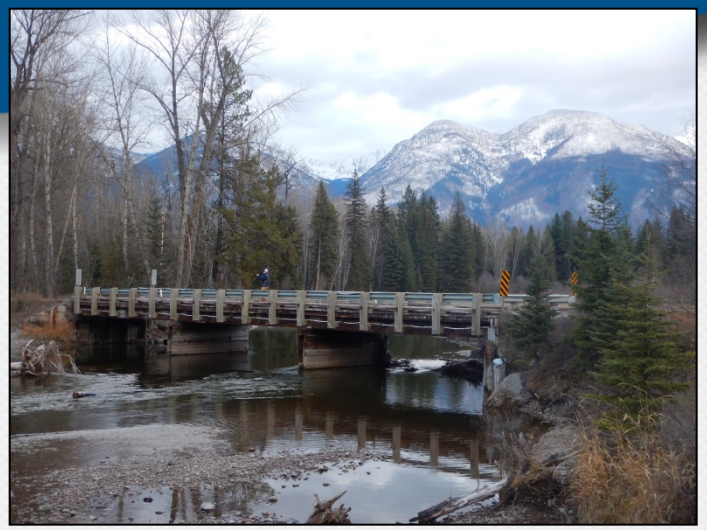
Presentors

Todd Klietz
Greg Gabel
Josh Robbins

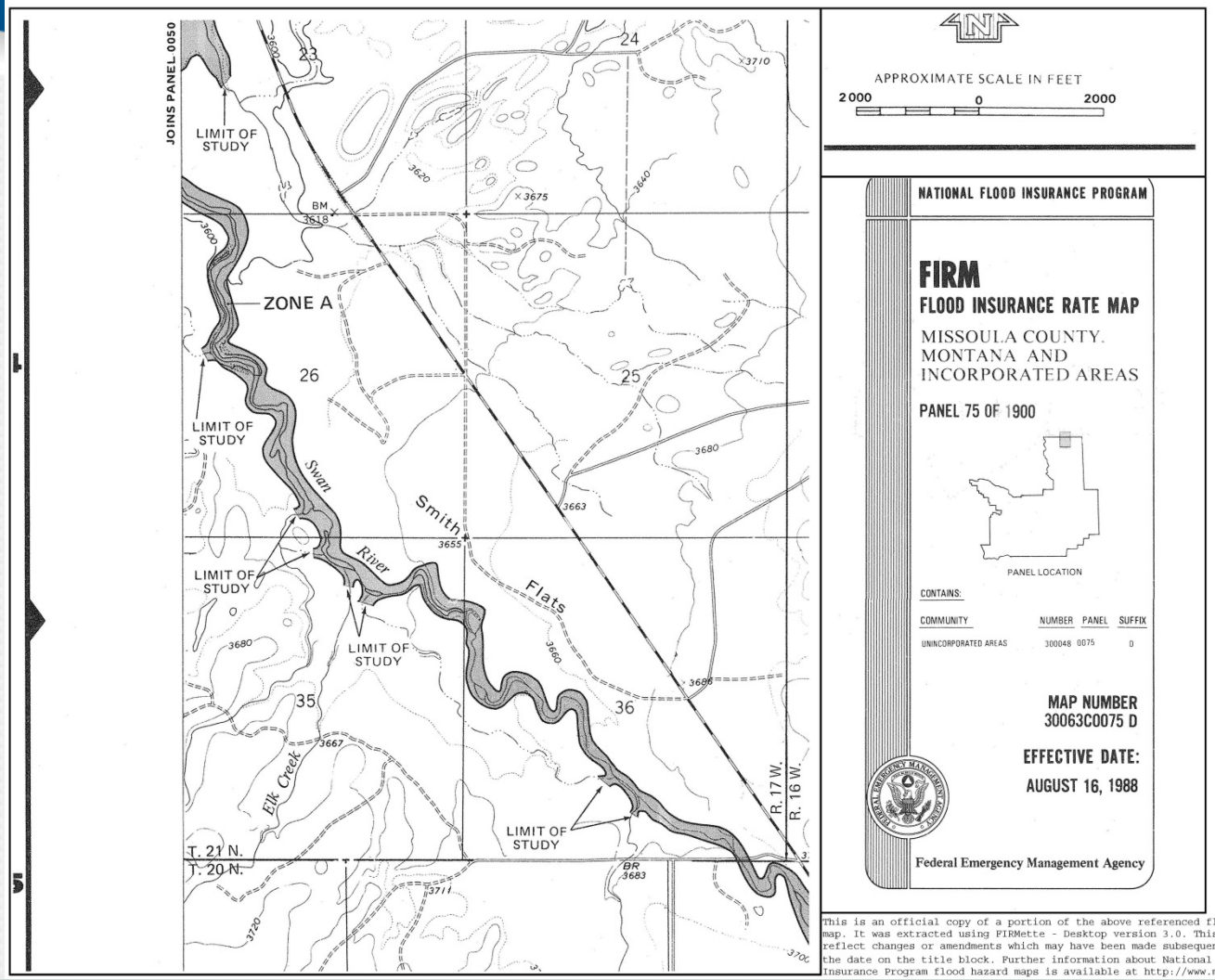
March 9th 2017

Today's Presentation

- Project Background
- Study Area Overview
- Original Flood Study
- Hydraulic Modeling
- Floodplain Mapping
- Public Outreach
- Project Status
- Questions

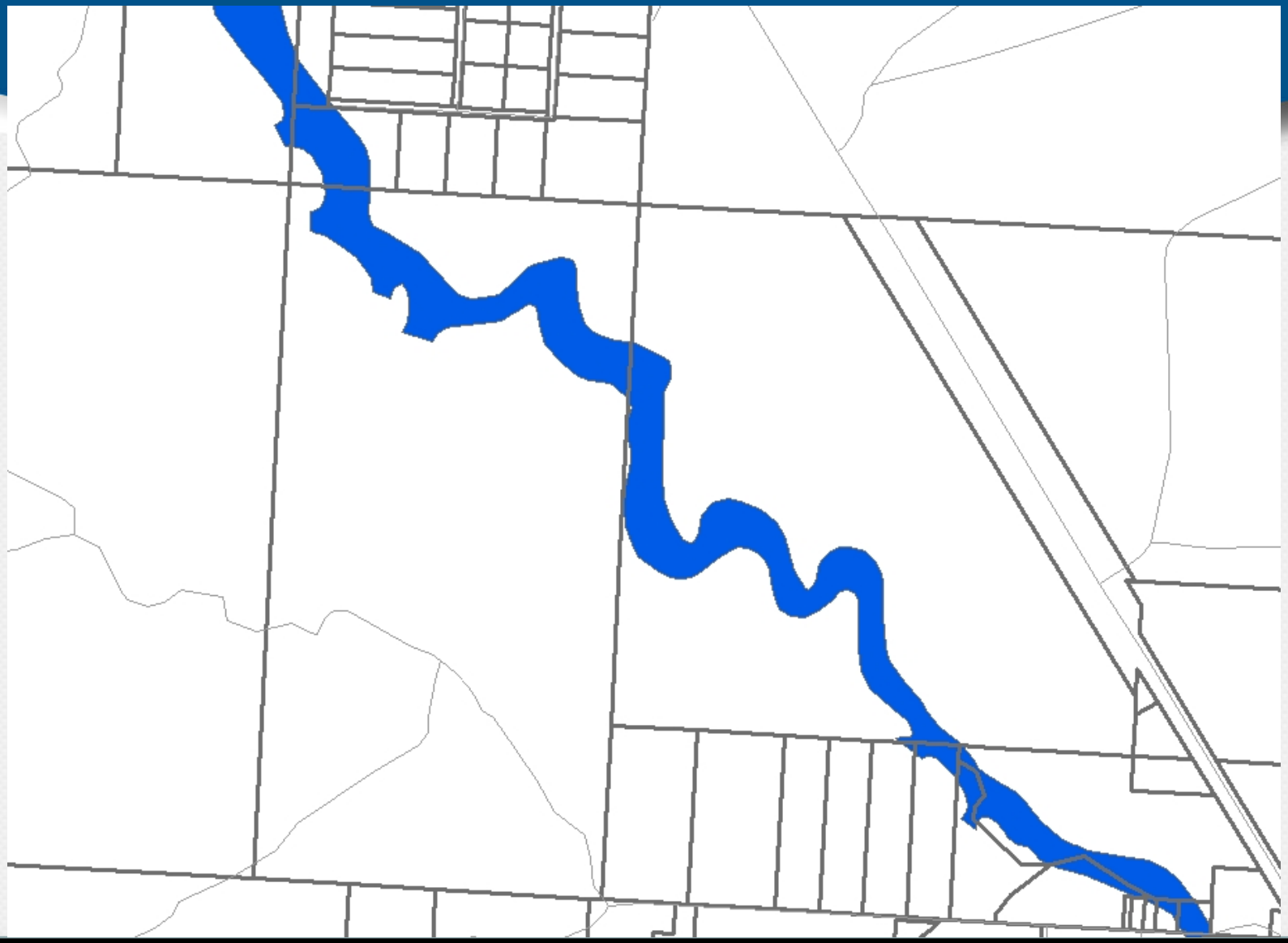


Project Background



This is an official copy of a portion of the above referenced flood map. It was extracted using FIRMette - Desktop version 3.0. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. Further information about National Flood Insurance Program flood hazard maps is available at http://www.msc.fema.gov/.

Project Background



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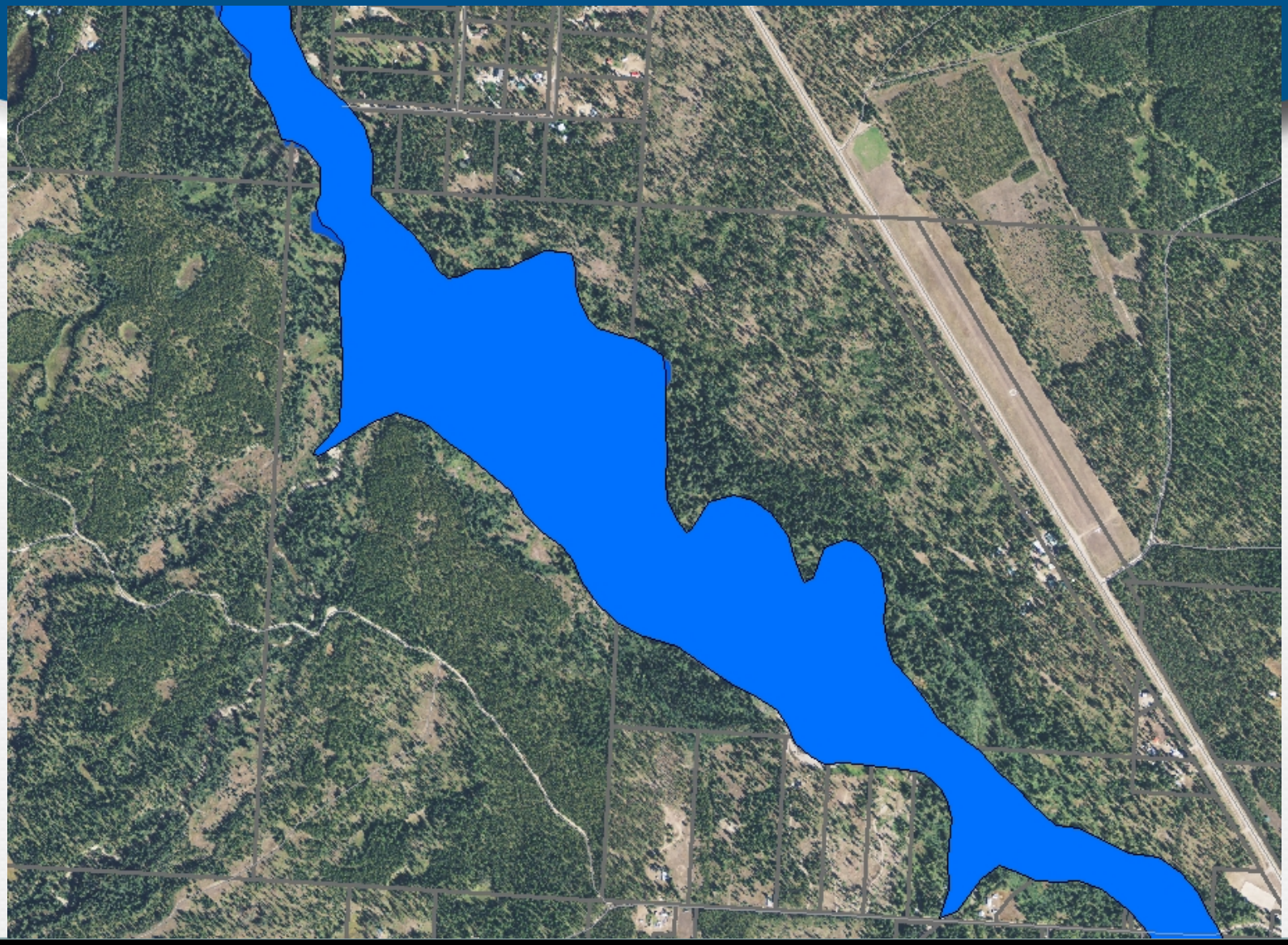


Project Background

Project Background

- 2005 Countywide Map Modernization Project Initiated
- 2012 Converted to Riskmap
  - Numerous appeals and questions about validity of the old mapping
- Mapping became Effective on July 6th 2015
- Missoula County Identified Swan River as Priority Study Reach
  - 2012 Secured State Grant to collect LiDAR data on Swan River Corridor
  - 2014 Requested Assistance from DNRC
    - Start of the Teaming Arrangement

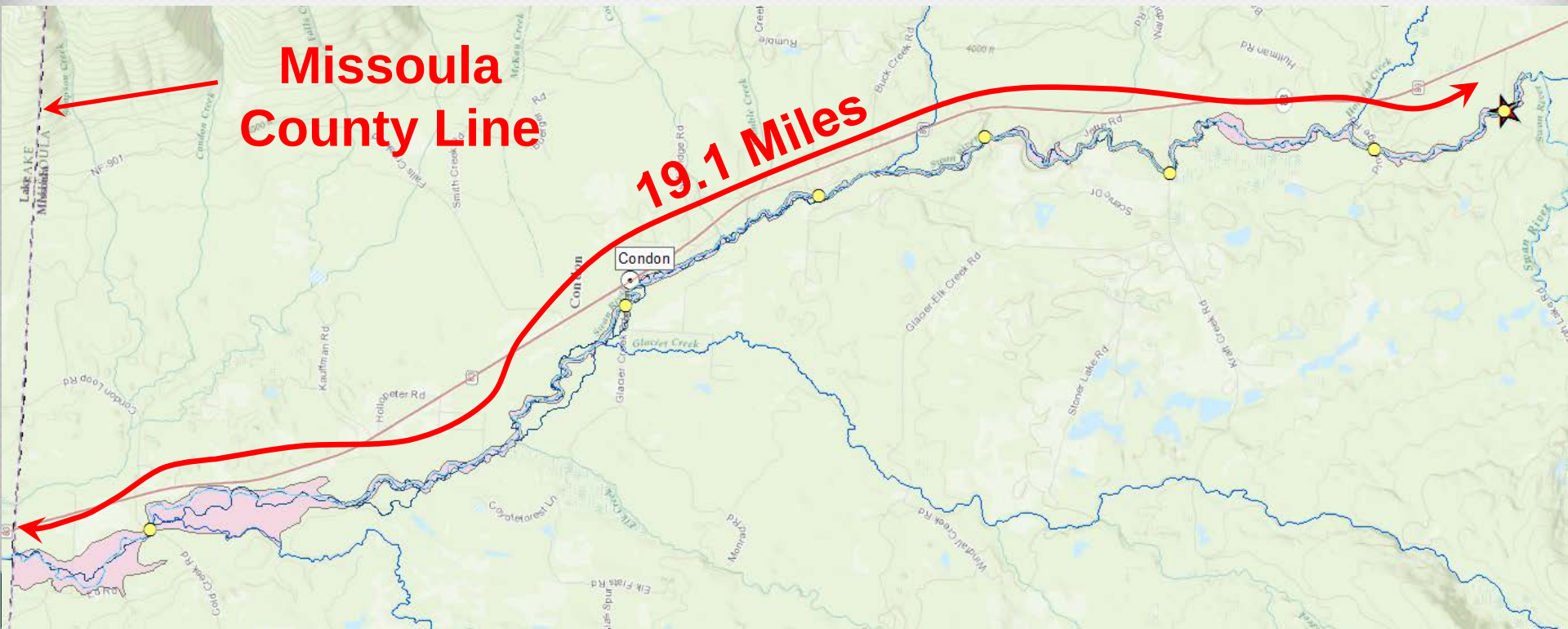
Project Background

- DNRC to manage the contract and perform hydrology evaluation
- Missoula County Agreed to complete Field Survey Work
- DNRC developed a 2015 FEMA grant request to complete the hydraulics and floodplain mapping
- Awarded the Grant in August 2015
- DOWL was selected as DNRC Contractor to complete the Hydraulic Data and Floodplain Mapping Submittals

Study Area

Study Area

- Between Seeley Lake and Bigfork
- Center of Reach is Condon, MT



Bridge Crossings

- Seven Major Crossings Structures
  - Includes Seven Bridges and One Major Culvert Crossing

Lindbergh Lake Road Bridge

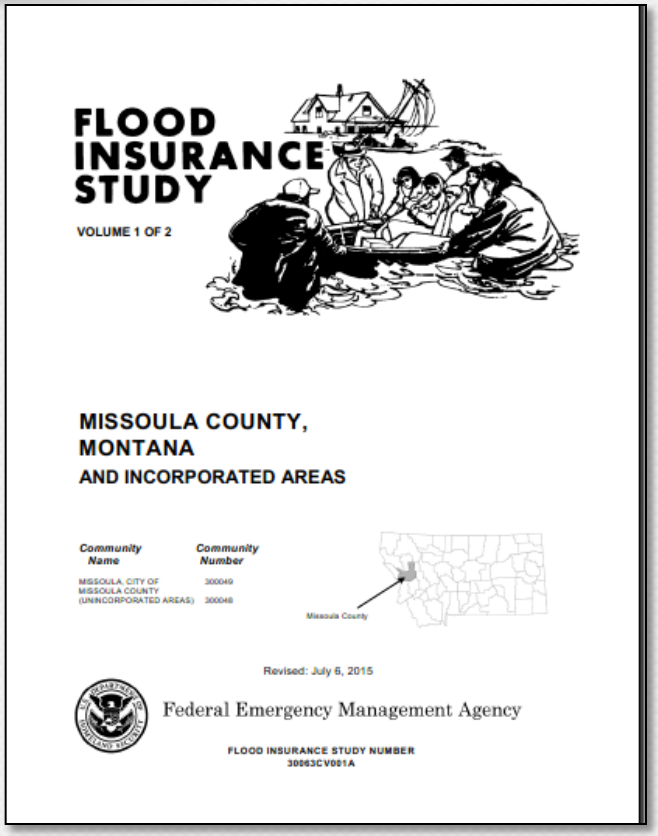
Kraft Creek Road Bridge

Flow Split Locations

- Four Flow Split Locations
  - Two Na

Original Flood Study

- Performed by HKM in 1978
- USGS Mapping & Limited Surveyed Cross Sections
- Approximate Methods
  - Engineering Judgement between surveyed cross sections



FLOOD INSURANCE STUDY

VOLUME 1 OF 2

MISSOULA COUNTY, MONTANA

AND INCORPORATED AREAS

Community Name	Community Number
MISSOULA, CITY OF	300049
MISSOULA COUNTY (UNINCORPORATED AREAS)	300048

Missoula County

Revised: July 6, 2015

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
30063CV001A

Original Flood Study

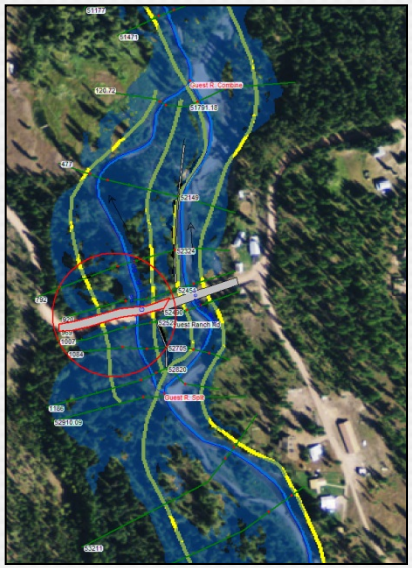
- Swan River Stream Characteristics
  - Upper Portions constrained in a Canyon
  - Lower Portion has a wider Flood Bench
  - Mobilization of Woody Debris during Floods
- High Potential for Channel Migration

Original Flood Study

- Channel has shifted since the Original Study

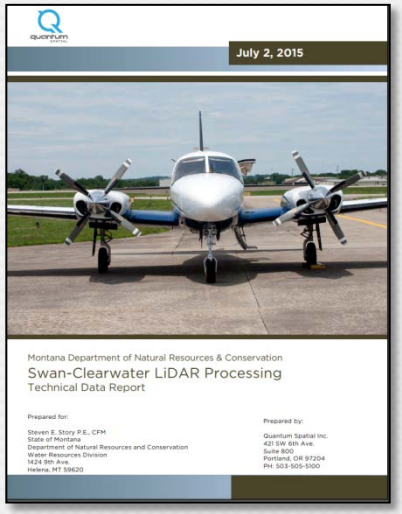
Updating the Mapping

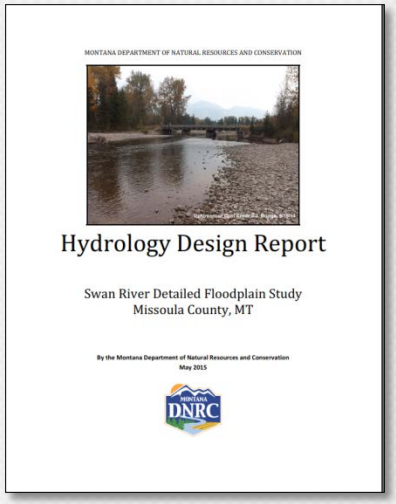
- Bringing Flood Hazard Mapping into the 21st Century
- Technology has improved since 1978
  - More Streamflow Data
  - Refined Topographic Data
  - Sophisticated Modeling Software
  - Automated Mapping Processes



Updating the Mapping

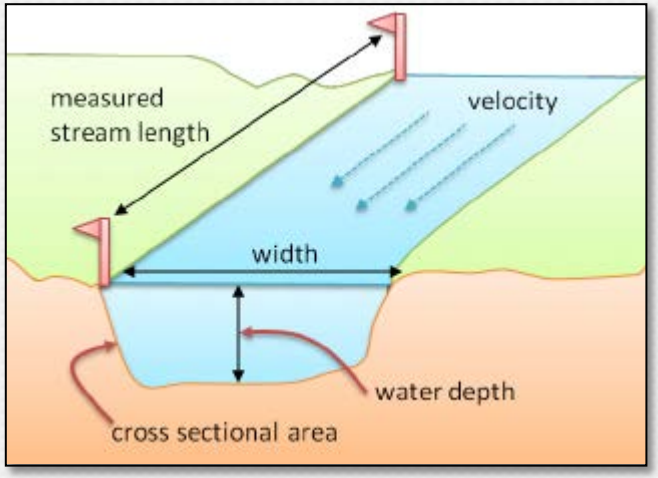
- Data
  - 2014 LiDAR Data
  - 2015 DNRC Hydrology Report
  - Missoula County Structure and Bathymetric Survey Data
- Our Portion of the Project
  - Hydraulic Data Phase
  - Floodplain Mapping Phase





Hydraulic Analysis

- Terrain Data:
  - LiDAR
  - Field survey (bathymetry):



- Develop Hydraulic Model
  - 289 Cross Sections
    - 56 Cross Sections had field survey
    - 233 Cross Sections without bathymetry

**** Need process to estimate bathymetry for 233 Cross Sections ****

Bathymetry Calculations

$$Q = \left(\frac{1.49}{n}\right) A \left(\frac{A}{P}\right)^{\frac{2}{3}} \sqrt{S}$$

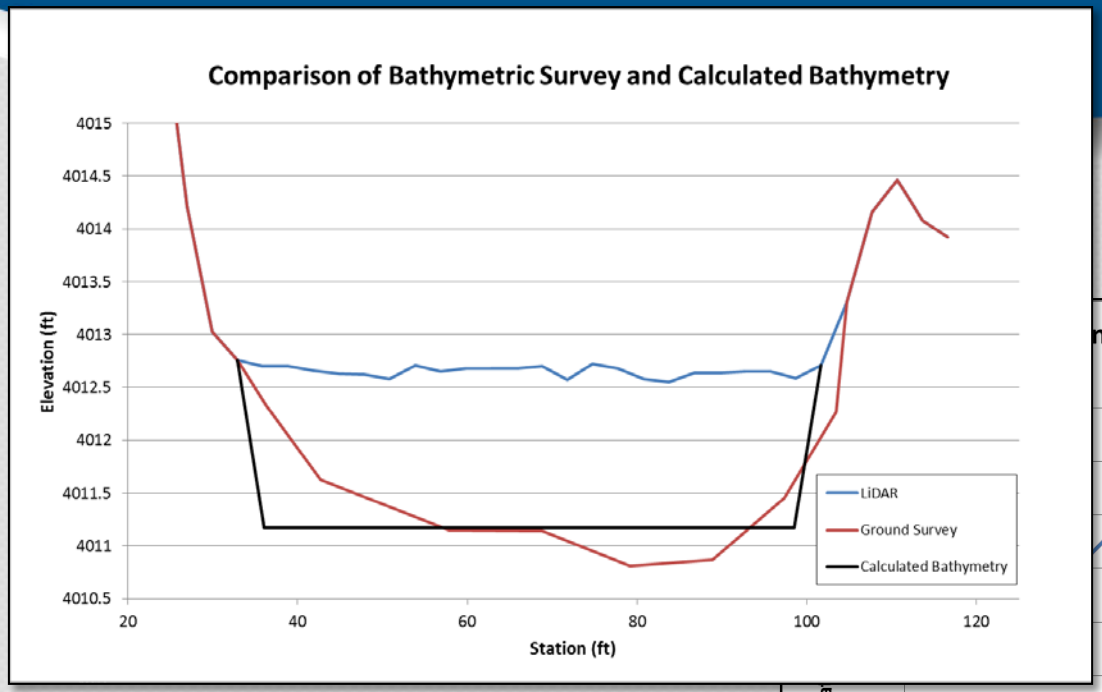
Manning's Equation

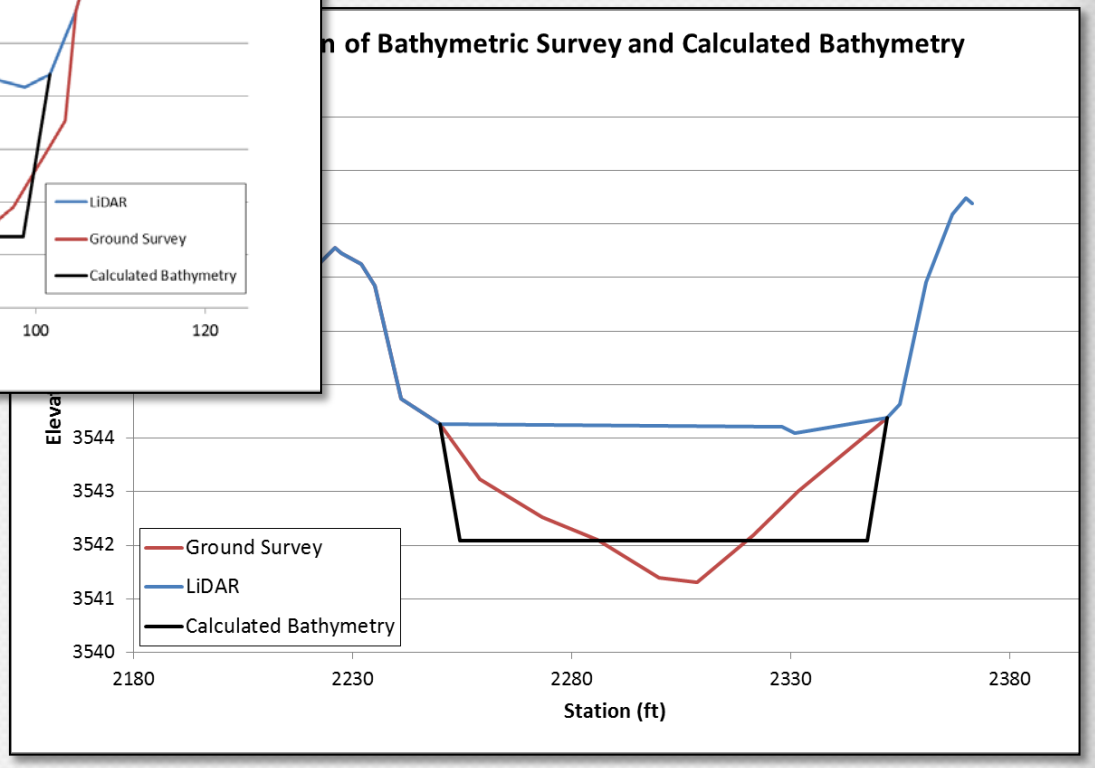
- What do we need?
  - Q, Stream gage data at time of LiDAR flight
  - S, Slope water surface (LiDAR)
  - Top Width of Water Surface (LiDAR)

Bathymetry Calculations

- Assumptions:
  - Trapezoidal Channel
  - Side slope
  - Manning’s Roughness at low flow
- Solve for Depth of flow

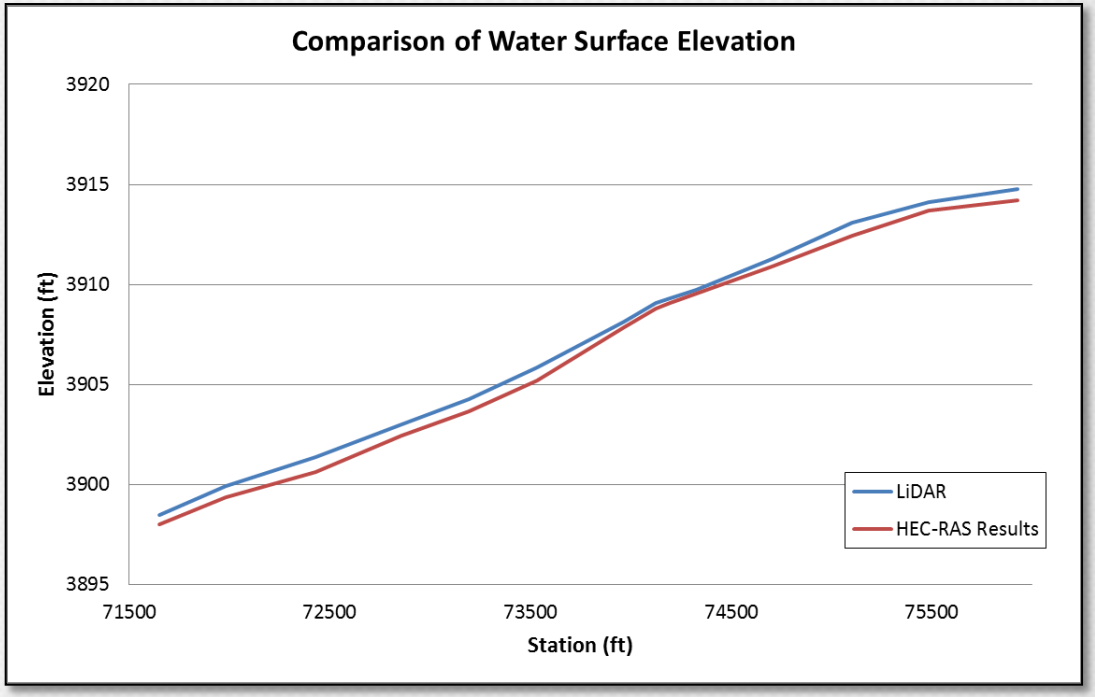
Validate Calculations





Second Check

- HEC-RAS Results vs. LiDAR
- Reasonable results
  - Higher roughness in low flow conditions



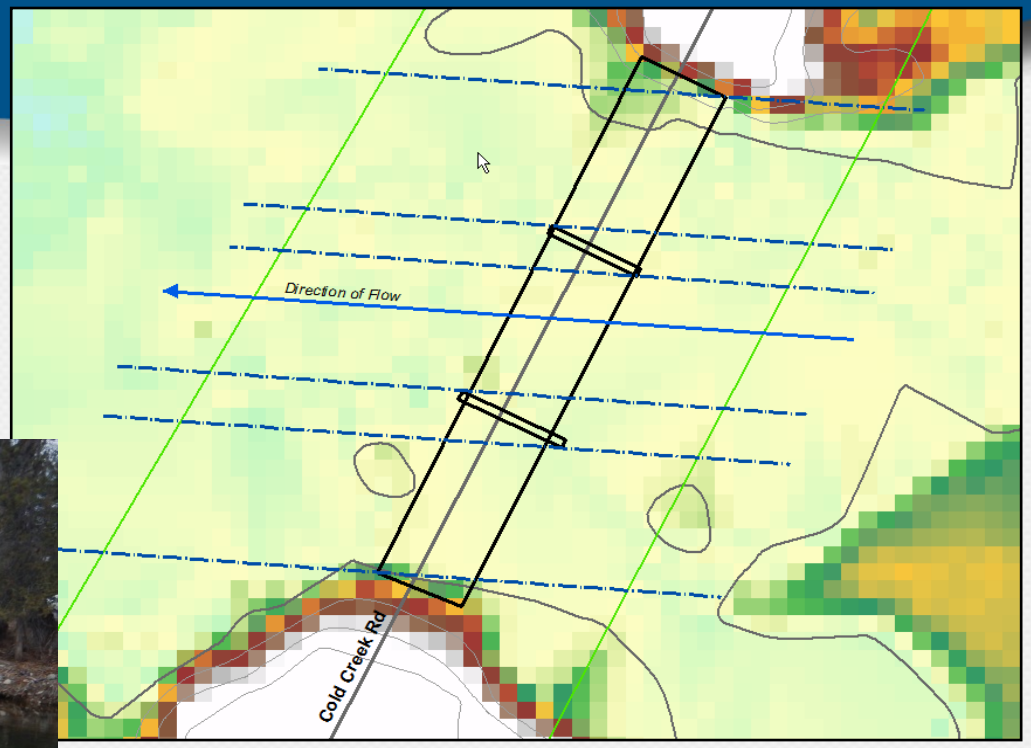
Incorporating Structures

- 7 Bridge Crossings
  - Lindbergh Lake Road
  - Pine Ridge Road
  - Kraft Creek Road
  - Highbank Lane
  - Glacier Creek Road
  - Guest Ranch Road
  - Cold Creek Road

Cold Creek Road

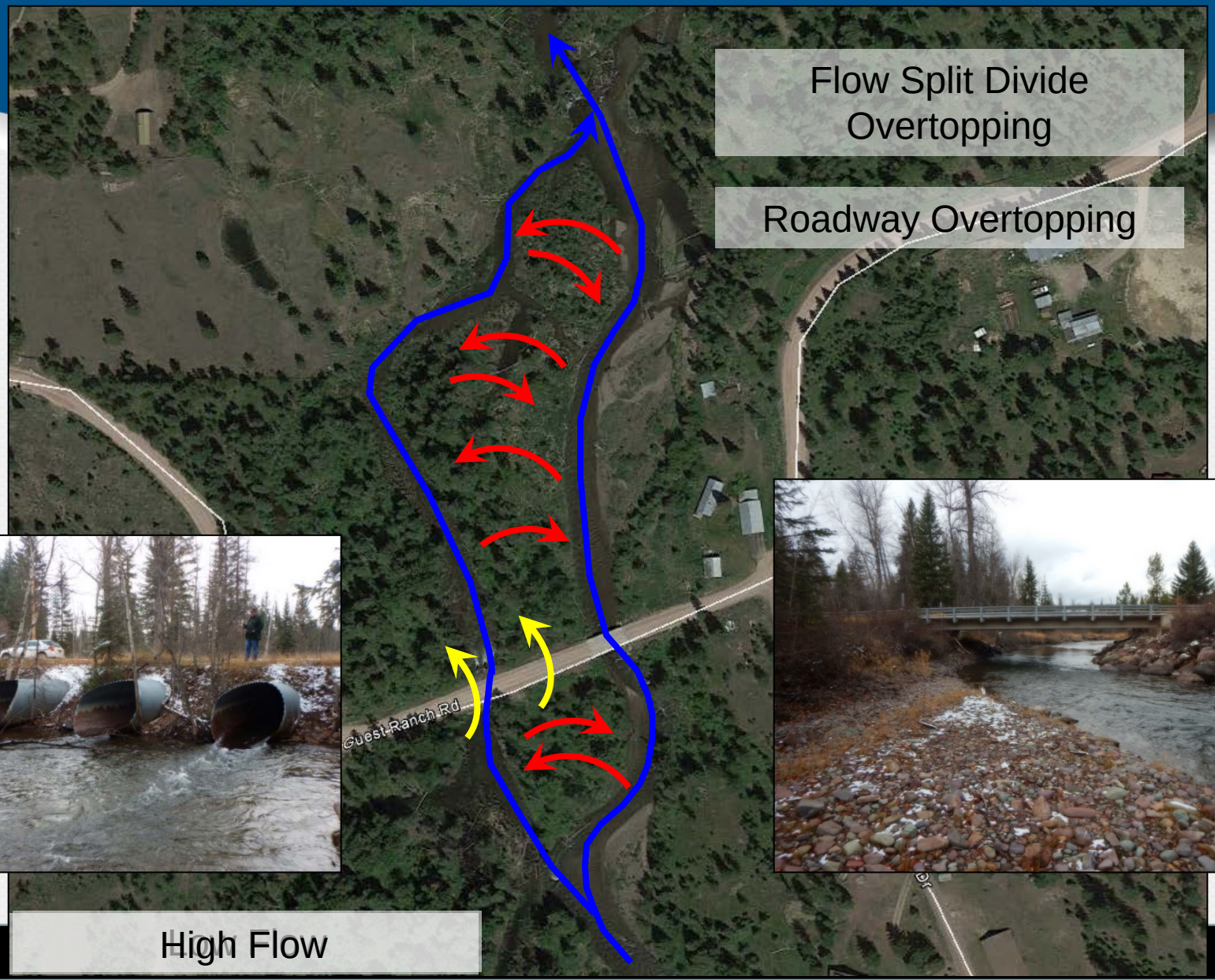
Cold Creek Road

- Pier Obstruction
  - Pier width 18 in
  - Now 7.7 ft



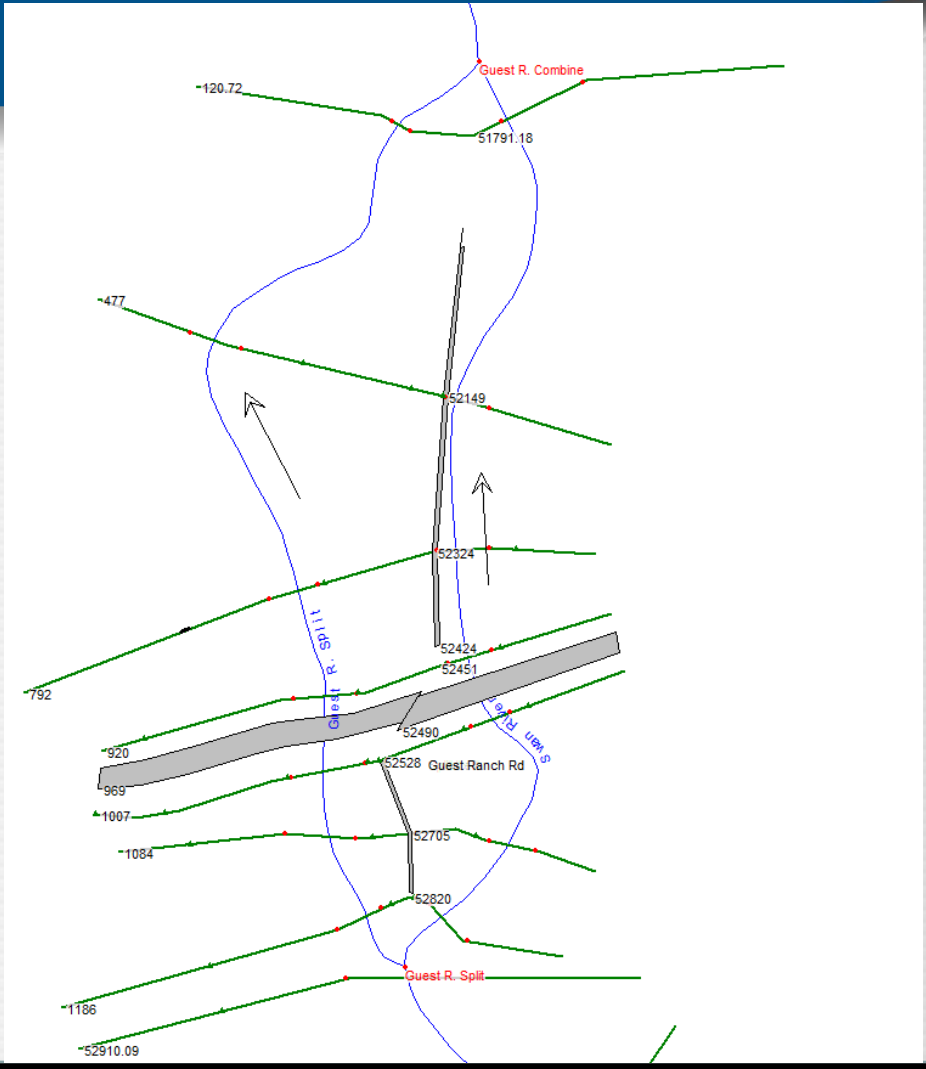
- No longer performs as designed
- Increased flood hazards

Guest Ranch Road

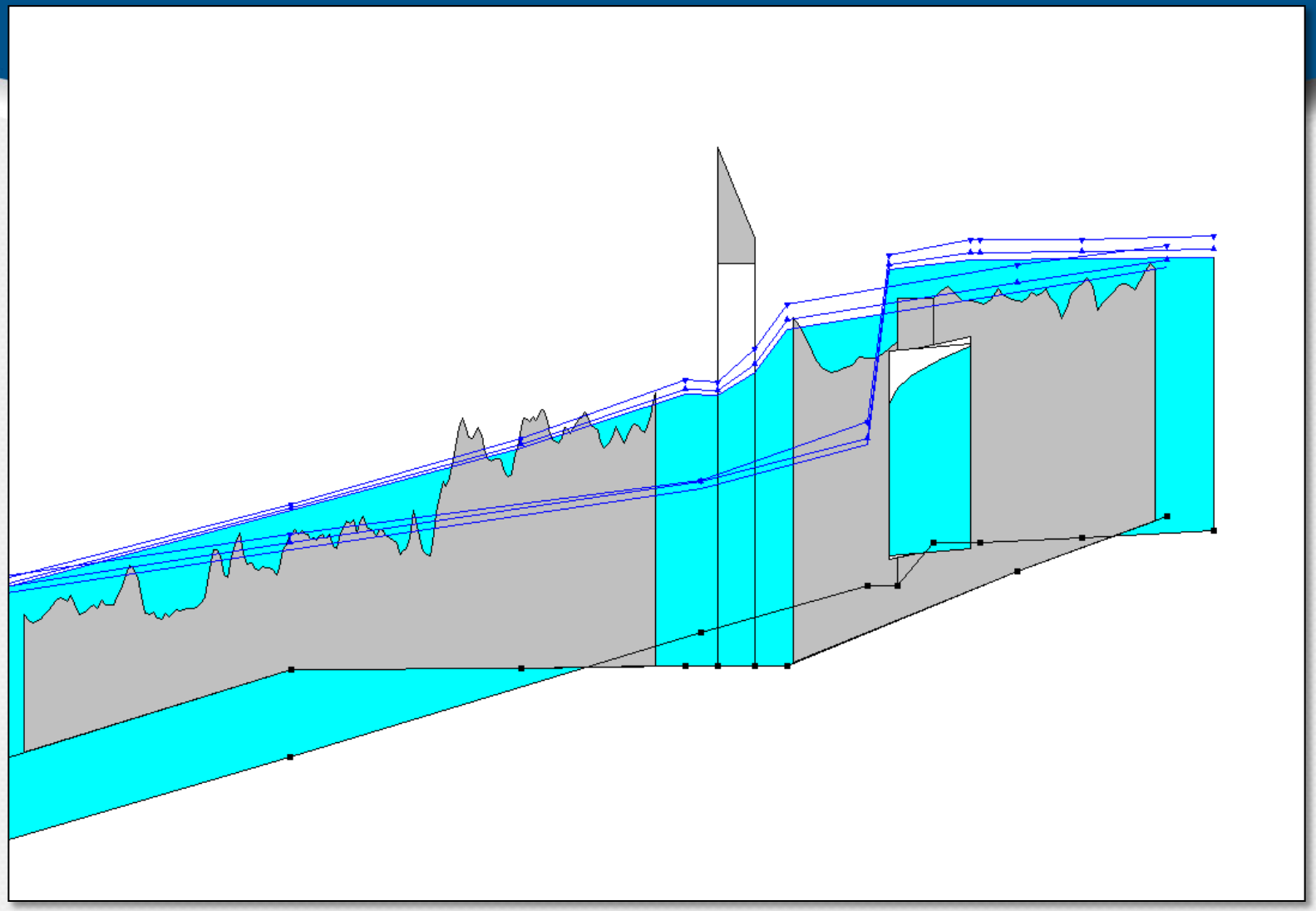


Guest Ranch Road

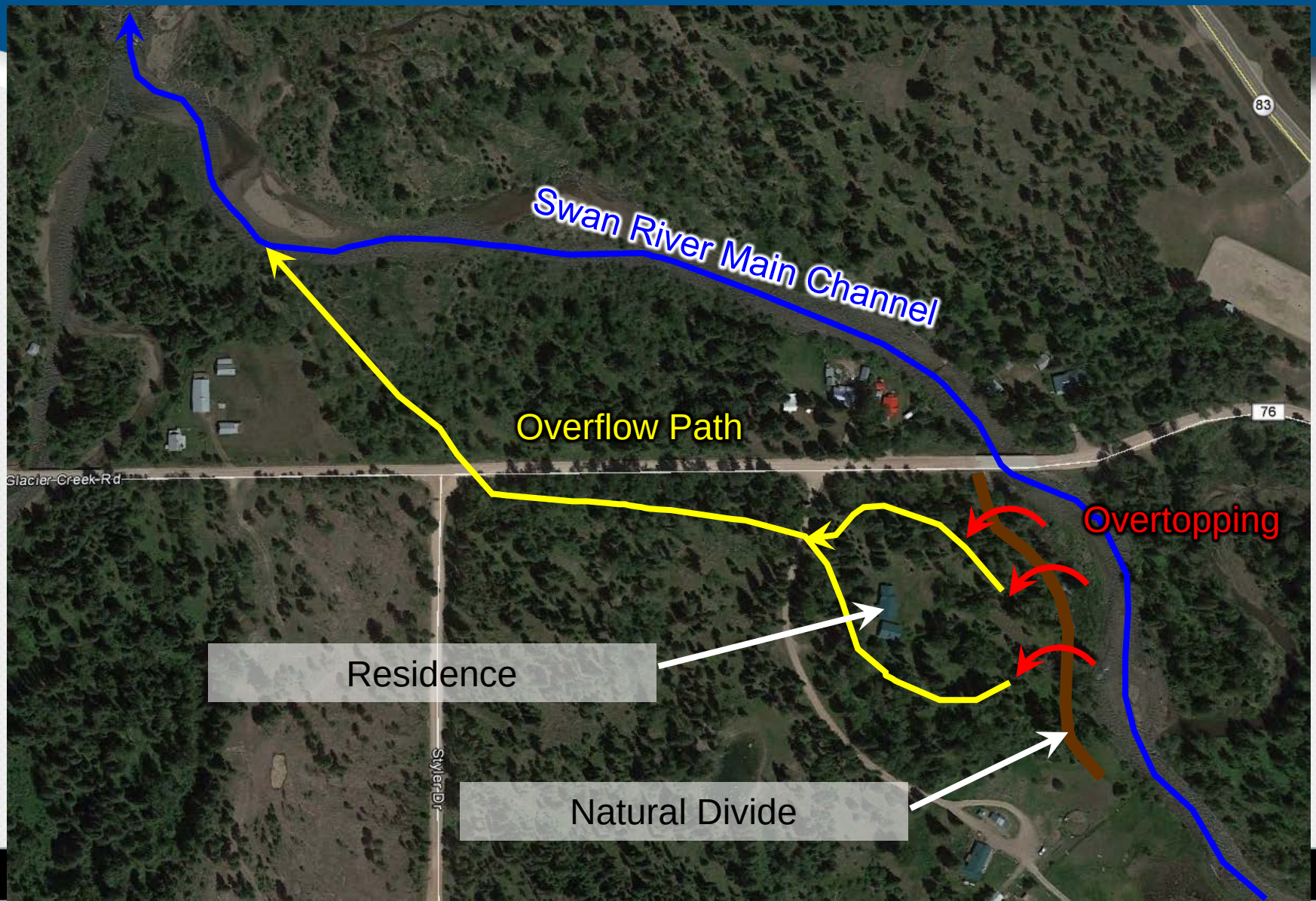
- Complex, Short Reach:
  - Two lateral weirs
  - Road overtopping
- Optimization would not converge
- Additional time for model stability



Guest Ranch Road

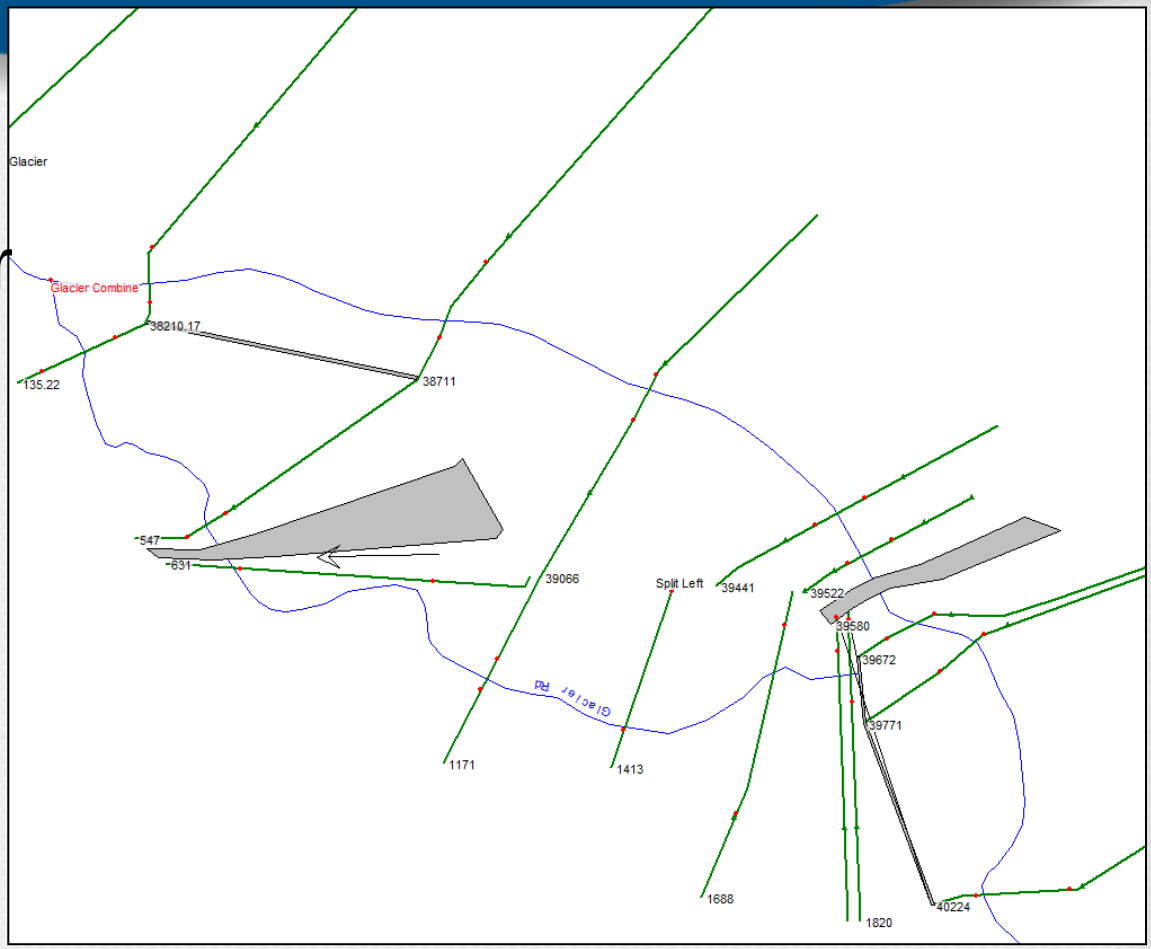


Glacier Creek Road

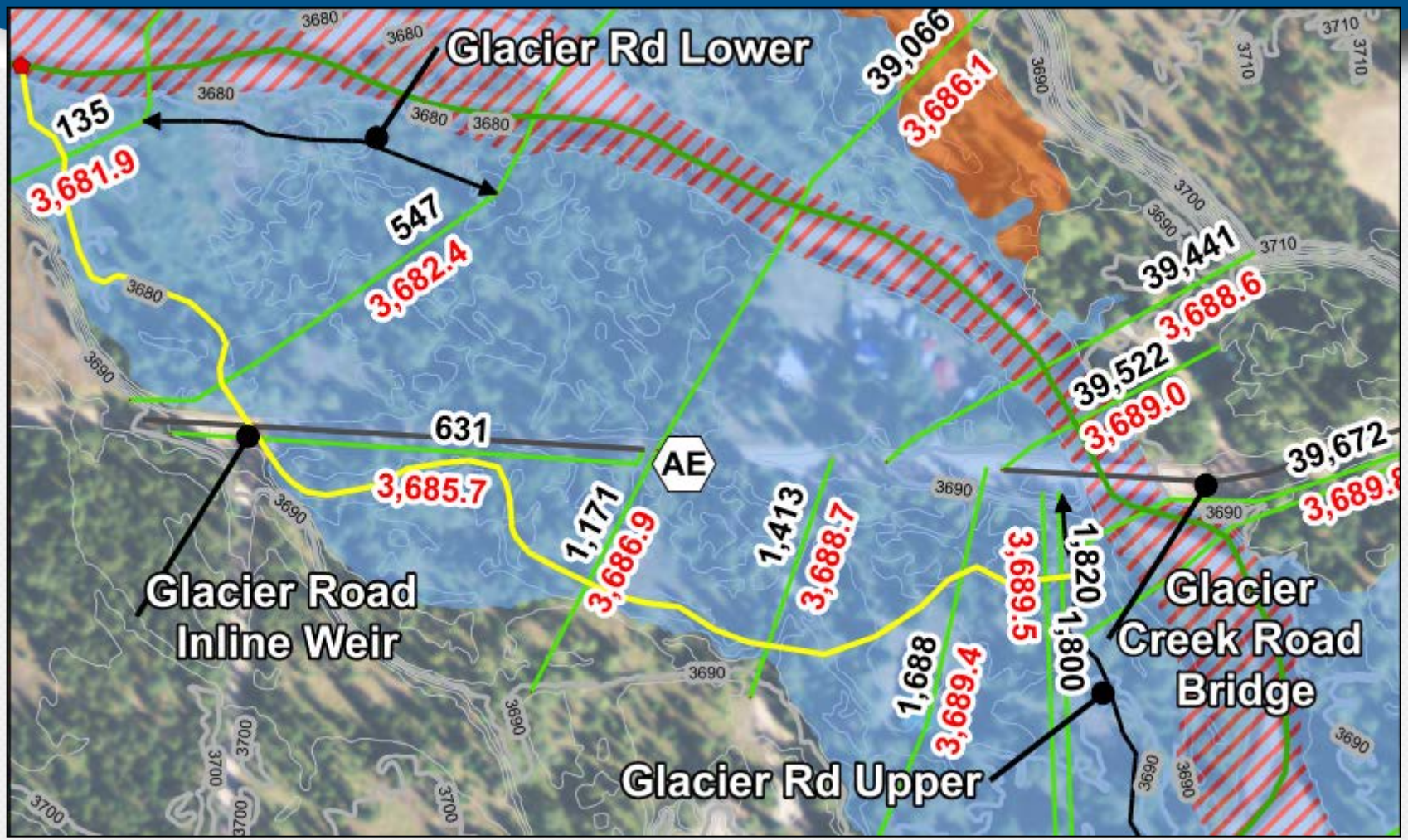


Glacier Creek Road

- Disconnected water surfaces
- Road Overtopping



Glacier Creek Road

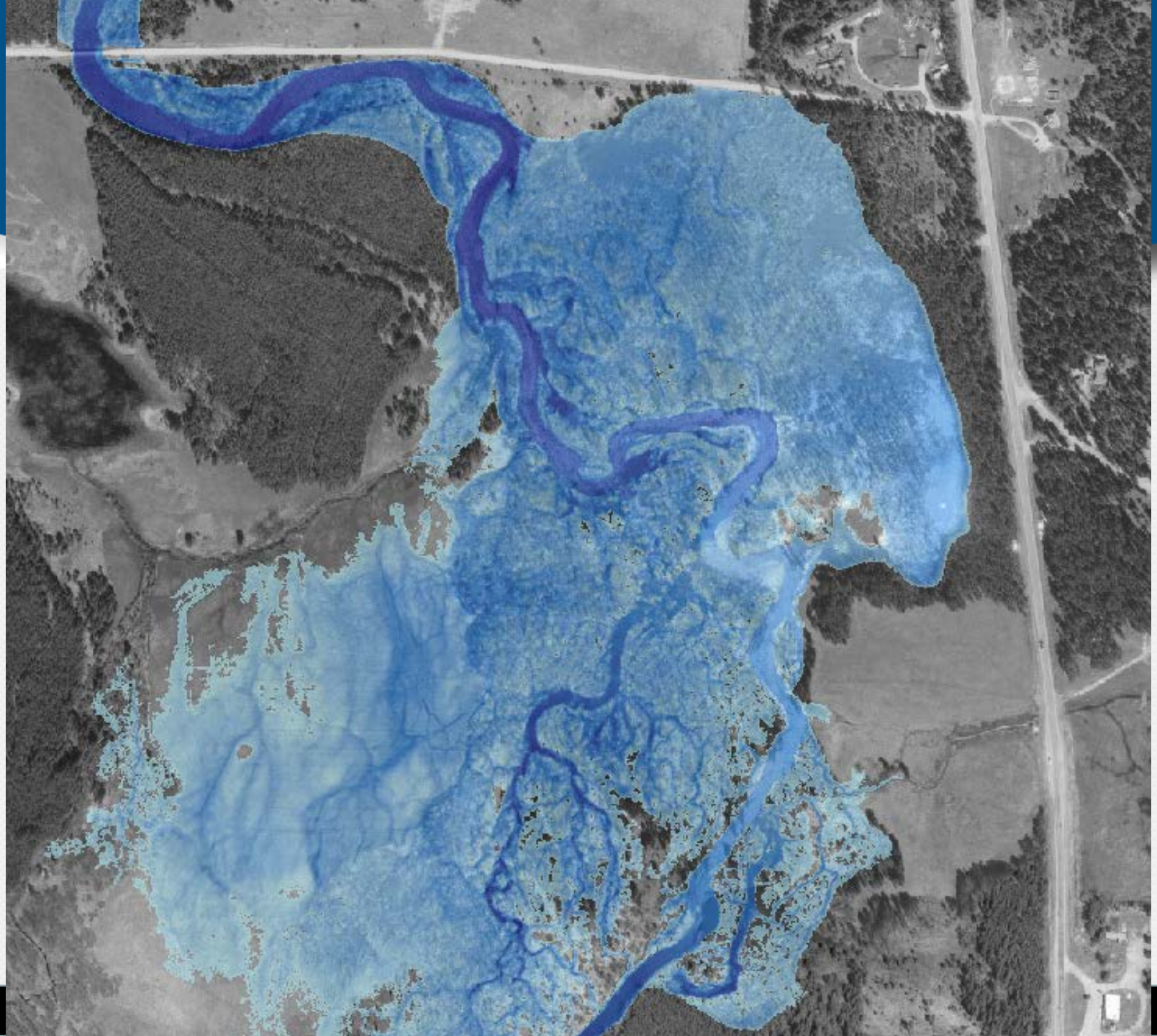


Calibration

- Model needs to represent real flood flows.
- How do we do that?
  - Aerial Photography during floods
  - Landowner observations
  - Highwater marks on structures
  - Debris drift

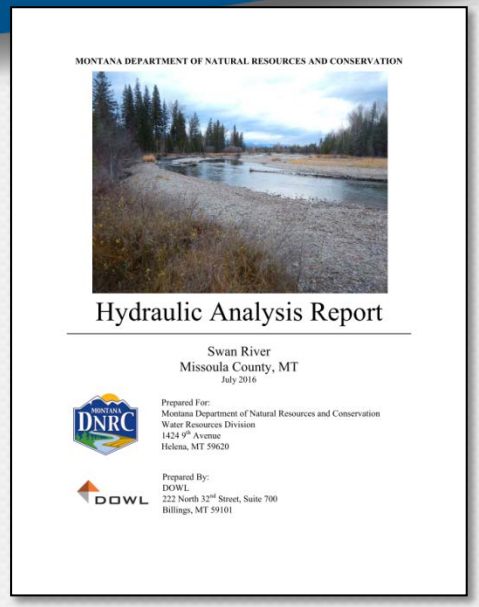
Calibration

- Model calibrated using two flow events:
  - Low Flow at time of LiDAR (October 2012)
  - May 1997 Flood Event (~50 YR flow)
    - Aerial taken 3 days after peak flow (~5 YR flow)
    - Traces, standing water from peak flow



Hydraulic Data Submittal

- Significant Deliverables:
  - Hydraulics Report and Draft FIS Sections
  - Metadata
  - Hydraulic Model
  - Profile Plots and Floodway Data Tables
  - Basic FIRM Database



MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

Hydraulic Analysis Report

Swan River
Missoula County, MT
July 2016

Prepared For:
Montana Department of Natural Resources and Conservation
Water Resources Division
1424 9th Avenue
Helena, MT 59620

Prepared By:
DOWL
222 North 32nd Street, Suite 700
Billings, MT 59101

- Hydraulic Data Schedule:
  - Initial Submittal: 2/10/2016
  - Received Comments: 4/11/2016
  - 2nd Submittal (approved by Compass): 5/03/2016

Floodplain Mapping

- Hydraulic Model approved
  - Develop final mapping boundaries
- Mapping Refinements:
  - FEMA Guidance
  - ‘Best Practices’
  - Engineering Judgement

Islands

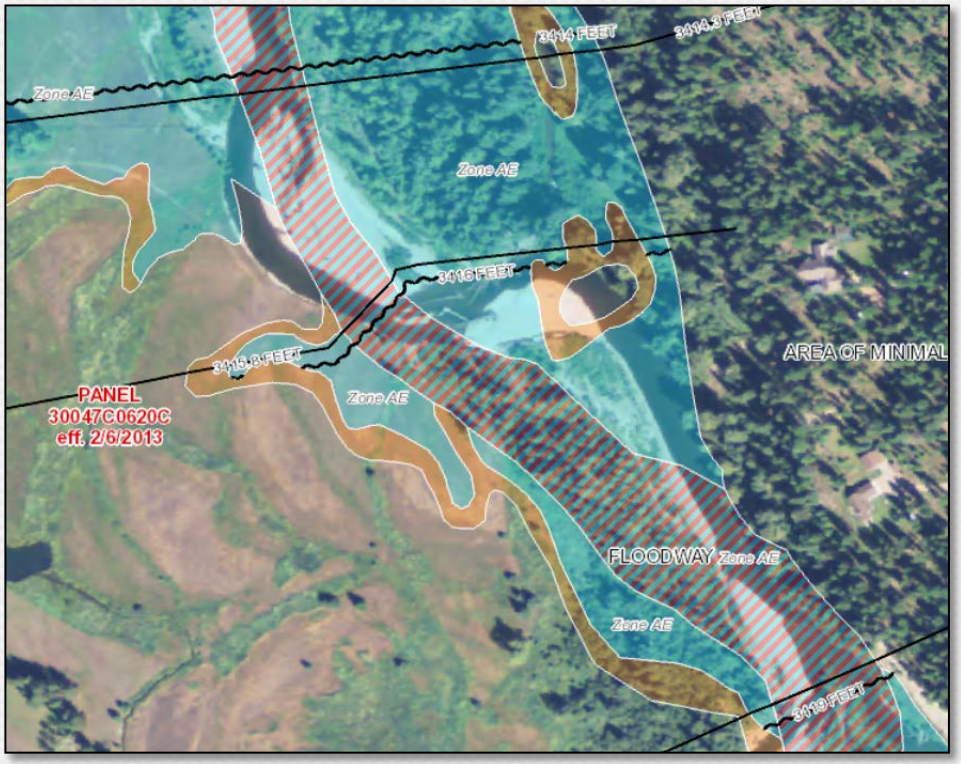
- Standard Guidelines:
  - Area of islands
  - Depth of water
  - etc.

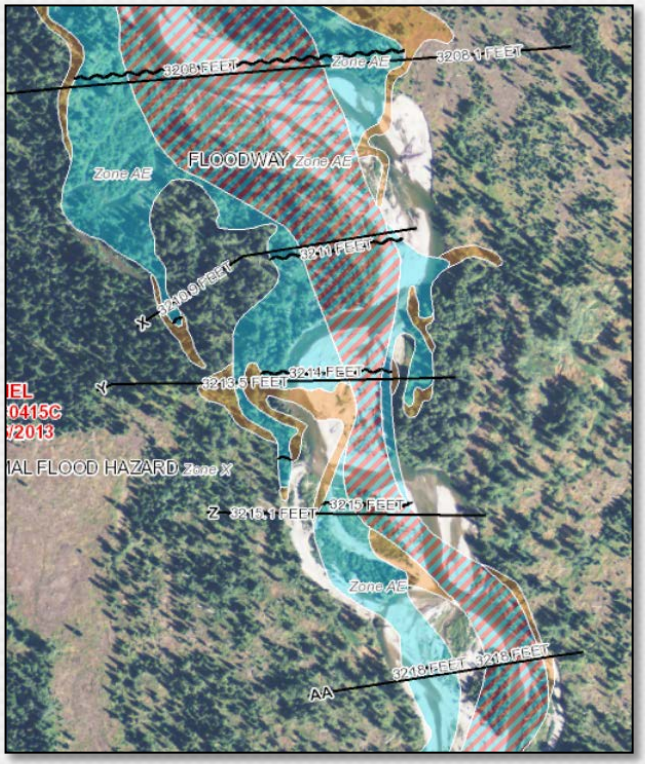
Islands

- Stream Characteristics of Swan River:
  - Dynamic Stream
  - Migrating Channel
  - Heavy Debris Load
  - Large Spring runoffs each year
- Is it reasonable to map islands for the Swan River?

Islands

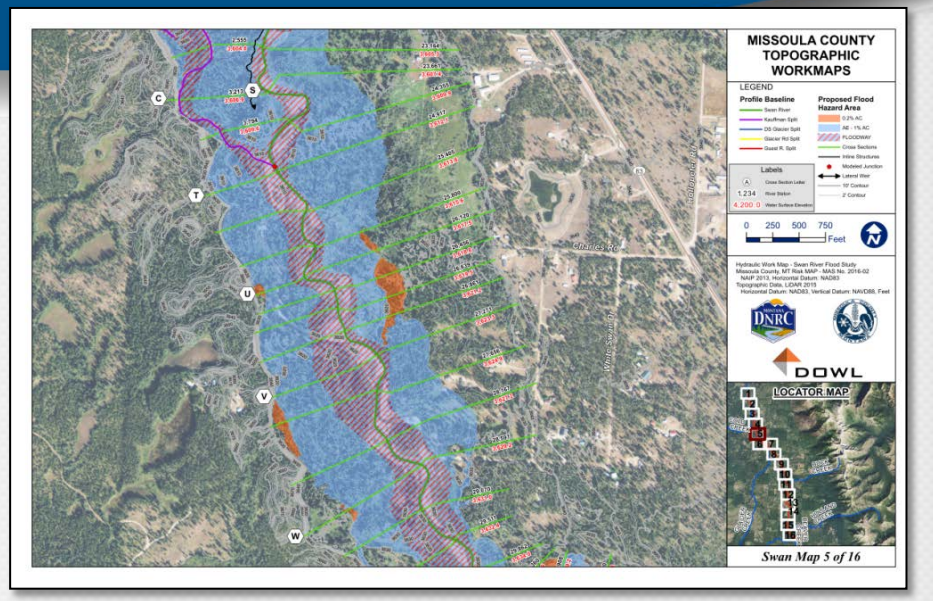
- Lake County Effective Mapping





Floodplain Mapping

- Deliverables:
  - Raw depth grids
  - Refined flood boundaries
  - FIRM Database products
  - Metadata
  - Workmaps



- Floodplain Mapping Schedule:
  - Had a couple revisions
  - Final Submission that was approved: 11/15/2016

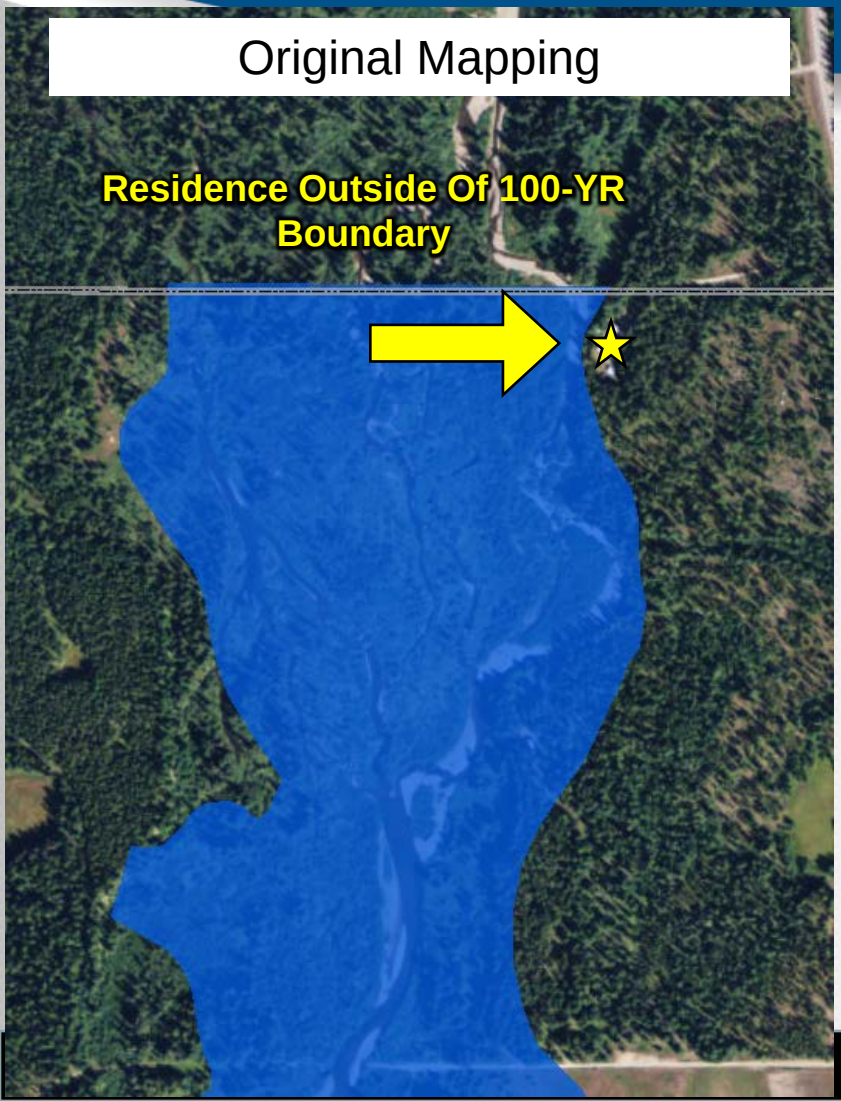
Public Outreach

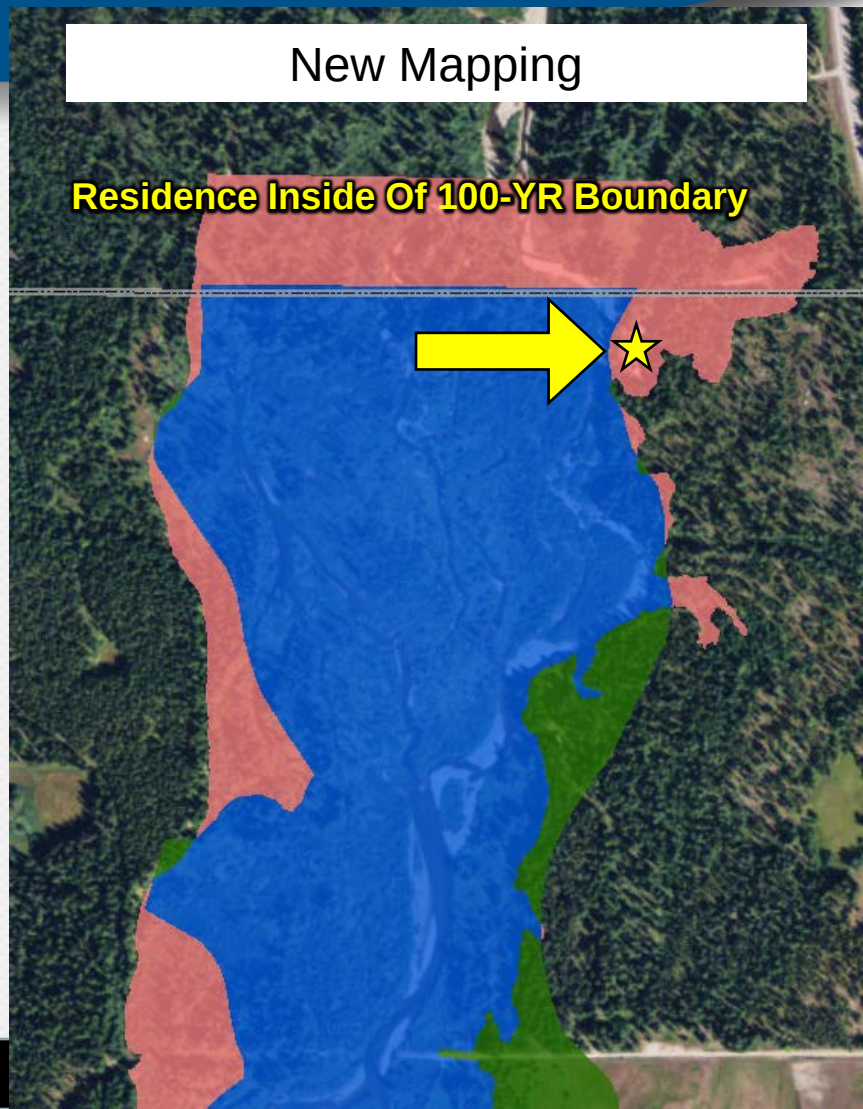
- Coordination Meeting with County Commissioners
- Public Meeting September 20, 2016
  - Missoula County Website
    - Interactive GIS Map
    - Work Maps
    - Hydrologic Report
    - Hydraulics Report
  - Meeting in Condon
    - Well Attended

Public Outreach

- Discussed the process with landowners
  - Calibration
  - Historical Observations
  - 1997 Flood
    - 50-Year Flood

Public Outreach





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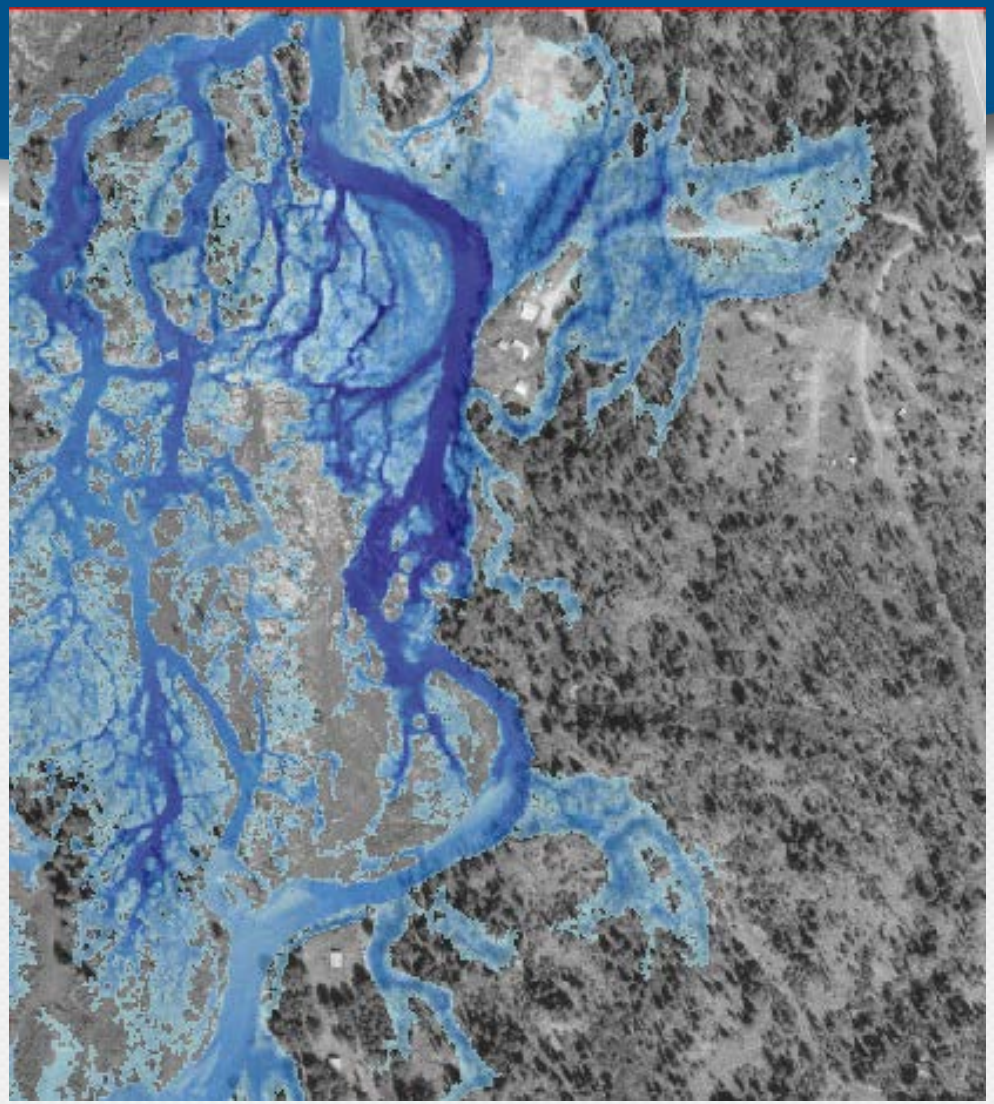

Project Status

Swan River Floodplain Study Project Anticipated Timeline

Questions

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