



#### Lancaster Clean Water Partners, Water Quality Monitoring Data Summit, October 22, 2019

1) We at WSI and F&M collect data on locations of milldams and <u>geometry</u> of sediment stored in millpond reservoirs <u>before</u> and <u>after</u> dam removals from airborne lidar.

2) From this data, we estimate how much sediment (in cubic meters and tons) is stored in a reservoir before dam removal, and how much is left in terraces after dam removal and channel incision.

3) We collect data on how streams evolve and erode after dam removal. Stream banks are fine grained and sticky, so they are relatively strong and hold a near vertical face. They erode by slumping, calving, and freeze thaw, but not until channel incision occurs (i.e., after dam breaching). In cases where dams were removed recently, channel bed incision is still occurring.

4) We collect data on how fast streams erode banks after dam removal, using repeat cross section surveys, drone photogrammetry, and airborne lidar data. With the latter two, we can do change detection via dem differencing.

5) We find that bank erosion is most rapid during the first 5-10 years after dam removal. We predict that it is especially rapid once gravel bars have begun to form, but this process takes at least several years.

6) Using data that we collect on grain size and bulk density, we can convert cubic meters of erosion per year—i.e., bank erosion rates--to tons of sediment going into streams per year, per unit length of stream.

Presented by Dr. Dorothy Merritts and Logan Lewis



# Historical archives, mapping, fieldwork, and lidar data

• Watershed Area: 282 km<sup>2</sup>



- Historic dams: 48 (8 intact)
- Dams/area: 0.17 dam/km<sup>2</sup>
- Remaining Historic Sediment Volume: 13 x 10<sup>6</sup> m<sup>3</sup>
- Average millpond volume: ~270,000 m<sup>3</sup>
- (one  $m^3 = 1.3$  tonnes)
- Sediment in storage now accounts for ~5 cm of landscape lowering
- Average long-term erosion rate: 0.3 m<sup>3</sup>/year/m stream length (~ 0.4 tonnes/year/m stream length)

Mapping: Logan Lewis

Stobers Dam, Indian Run, Lancaster County, PA

Dam breached in 2011























Source of aerial photo: Lancaster news, online







# Dam #1 (Hiestand milldam) before removal, 2015 Not erosional





## Dam #1 (Hiestand milldam) removal, 2015

# **Becoming erosional**



#### **Photo: Richard Hertzler, Lancaster News**



## Hiestand Sawmill Dam #1 3 years after dam removal



September, 2018 - View upstream from footbridge. Note deltaic sediments.







Krady mill dam #3 , <1 year after dam removal Drone photogrammetry, 2019, and repeat GPS surveying



Survey data (orange and green) and lidar dem differencing (blue) erosion rates per unit bank height 19 breached reservoirs (from 2008-2014)





## Roller mill dam #8 before removal—10 ft of mud upstream of dam



#### Roller mill dam #8 before removal—10 ft of mud upstream of dam





