Mt. Sterling Floodplain Sinks Flood Reduction and Pollutant Load Reduction Estimates

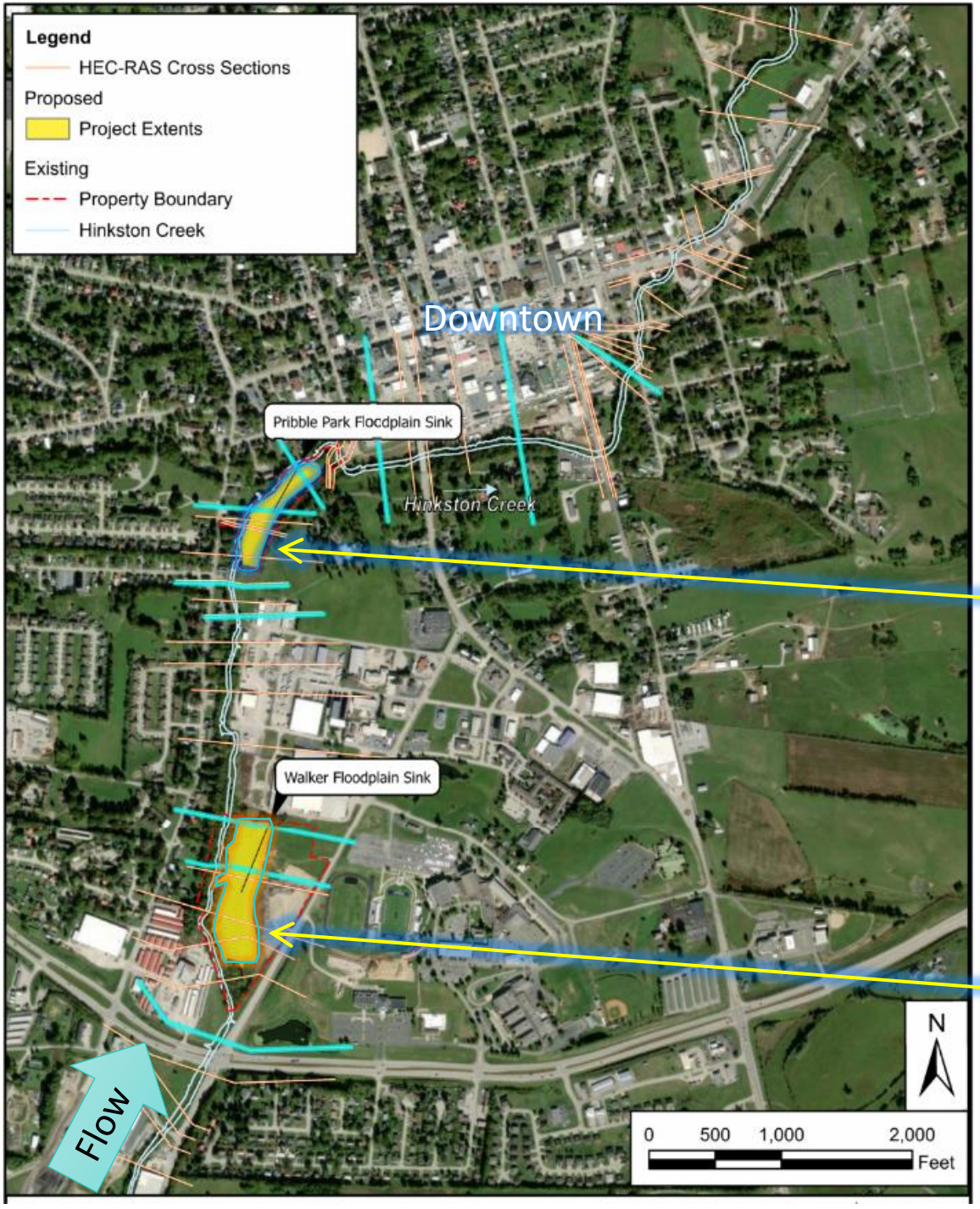
Based on Design and Modeling by
Sustainable Streams, LLC

Funded in part by 319(h) grant
Kentucky Division of Water

July 2026

Both Sinks Located Upstream of Downtown

Approach: Excavate sediment from the floodplain and route floodwater into sinks during flood events

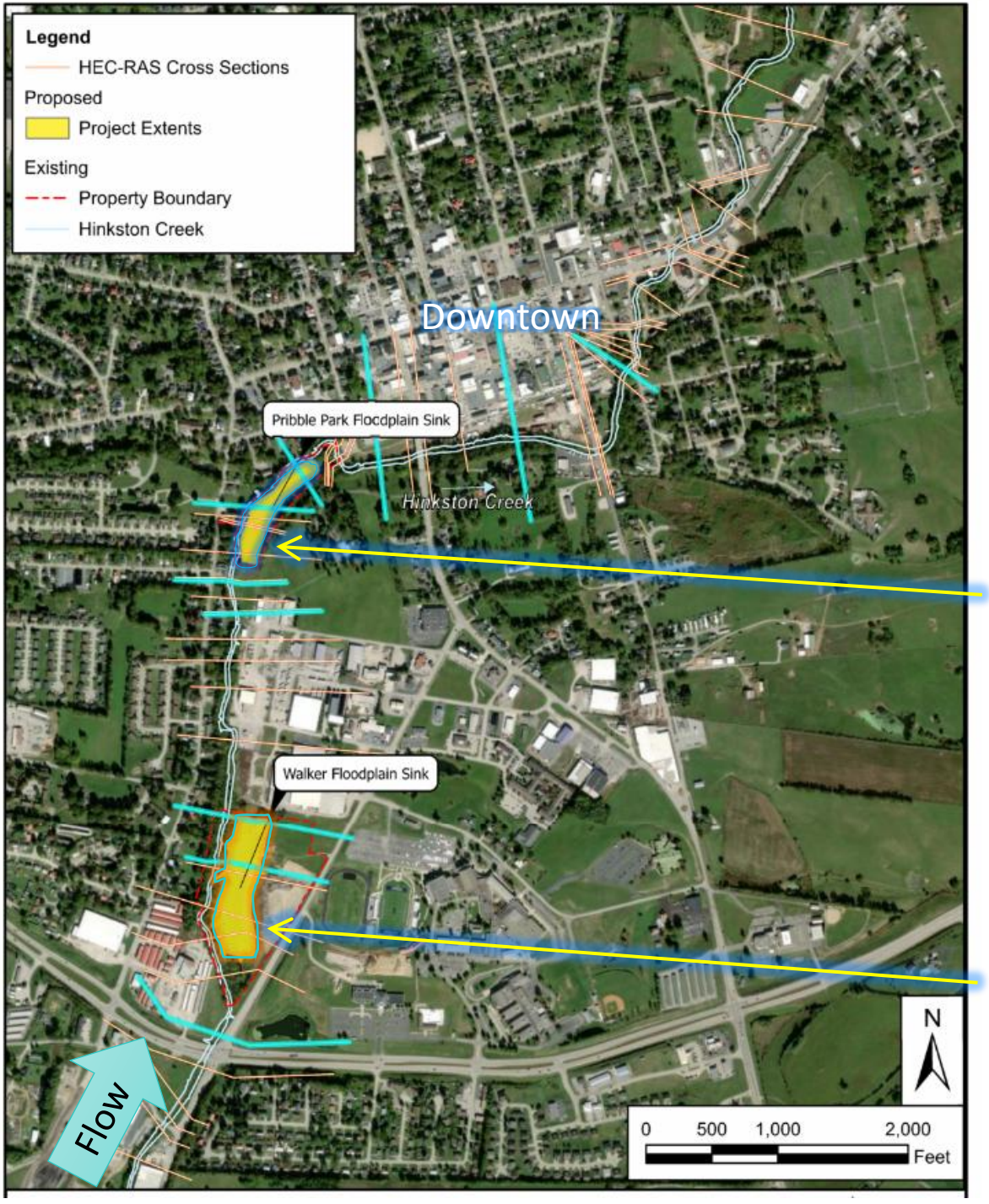


Drawings Are Nearly Final

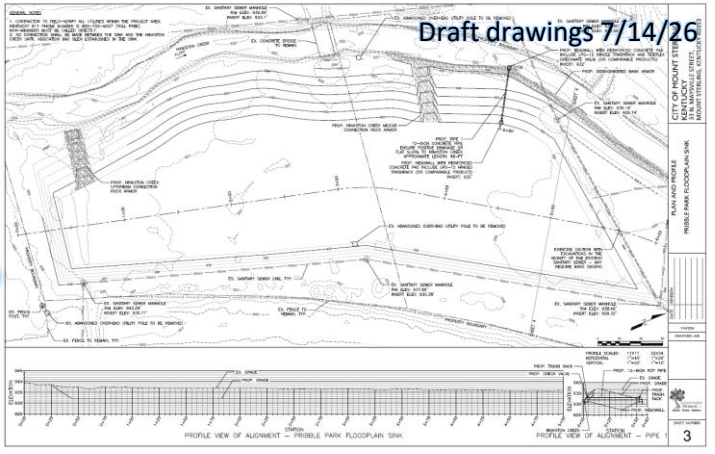
Access coordination & permitting phases

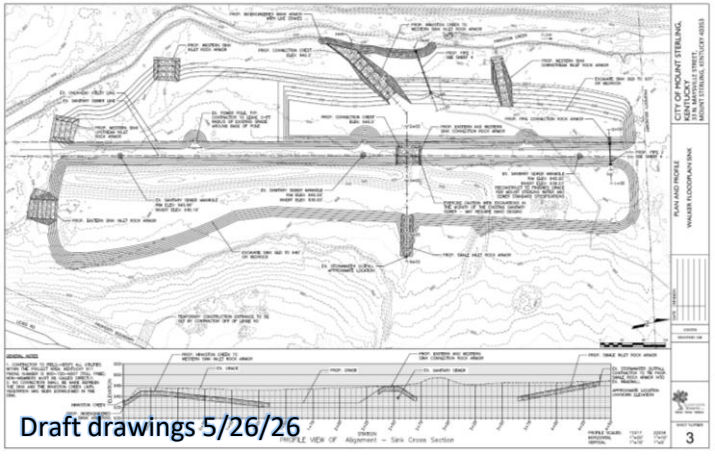
Sediment Removal from Floodplain:

- Pribble Park ~19,400 cubic yards
- Walker Sink ~55,500 cubic yards



Pribble Park – Proposed Conditions

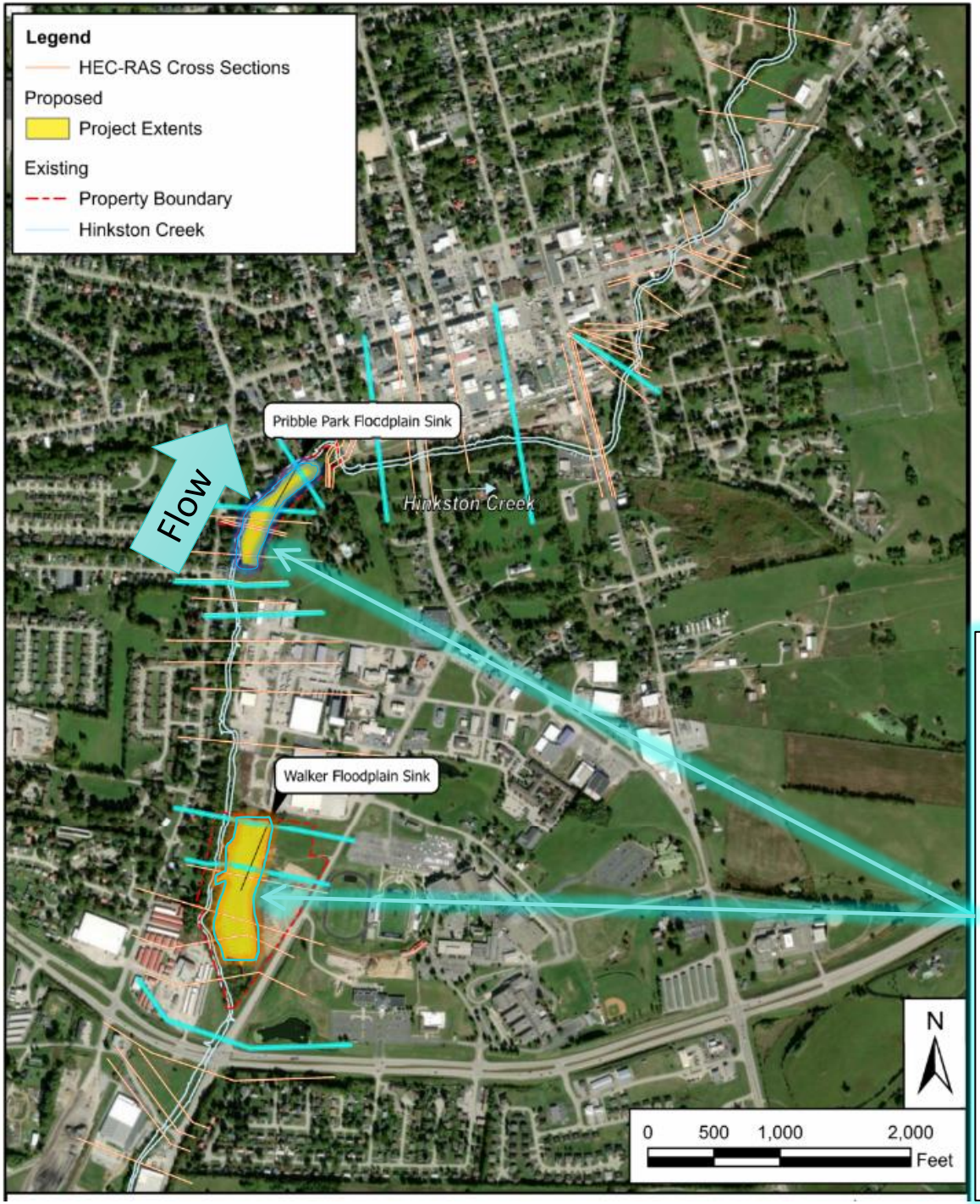




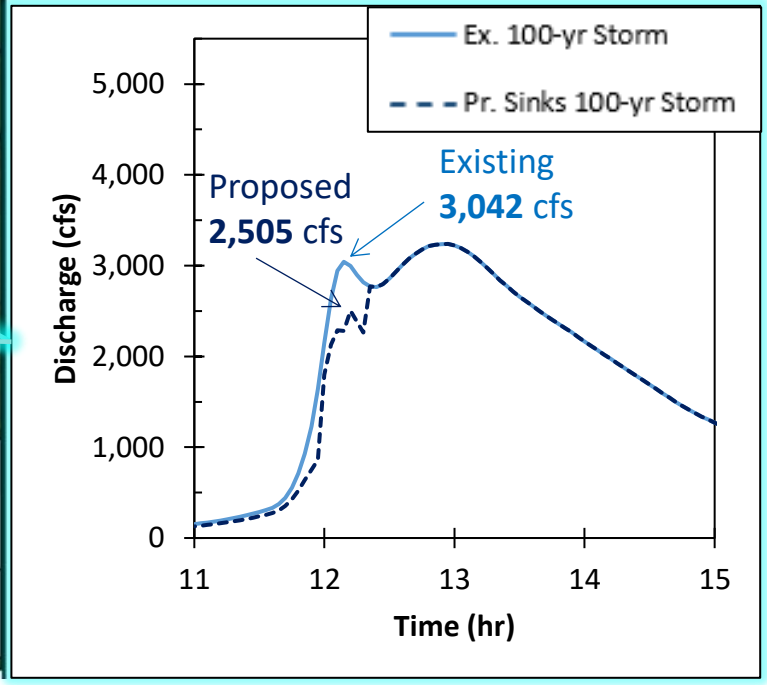
Walker – Proposed Conditions

Hydrologic (Sink) Benefits

When combined, both sinks reduce the rising limb of the 100-year design storm in Hinkston Creek (at the location of the "flow" arrow in the adjacent map) by ~540 cubic feet per second (cfs)

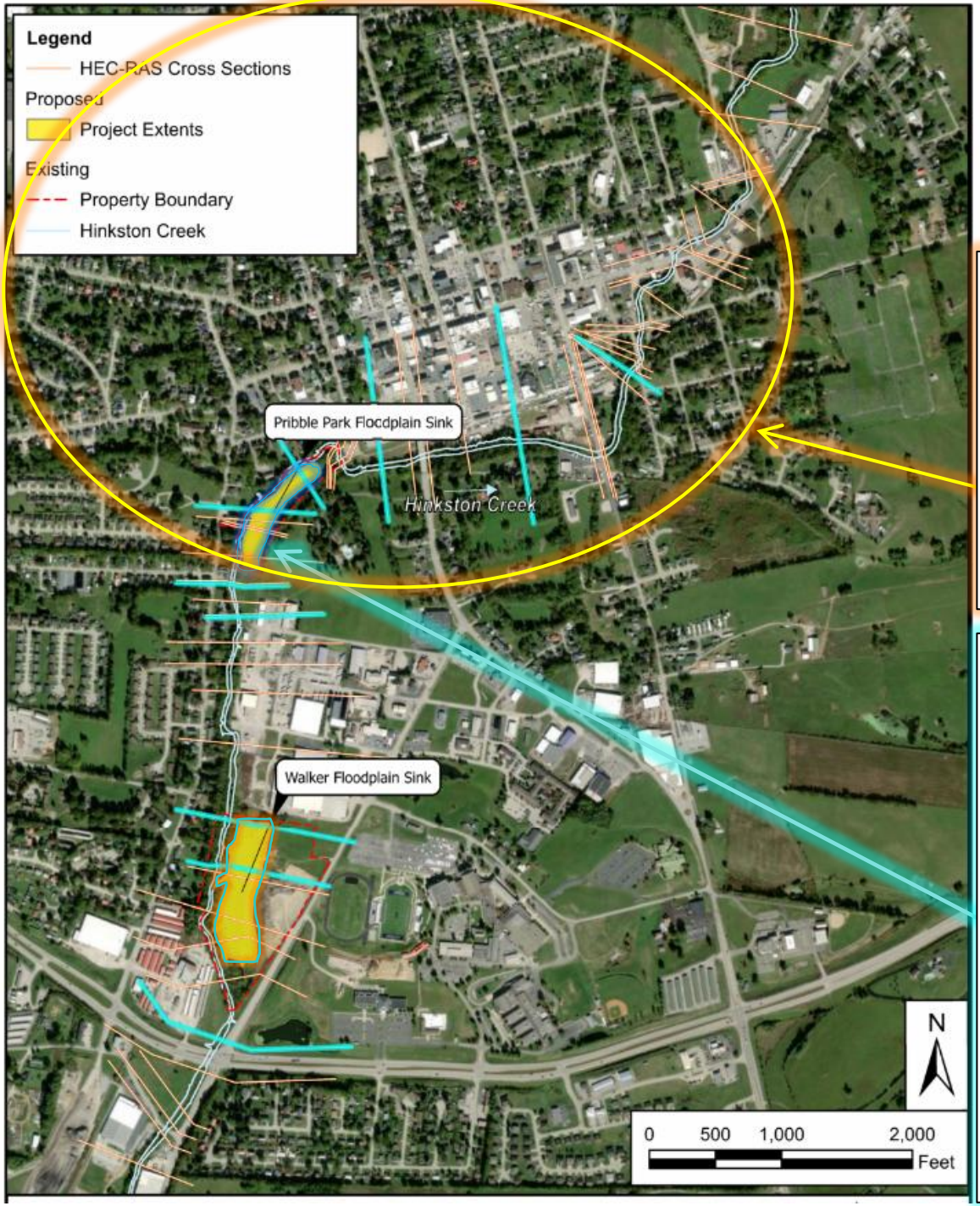


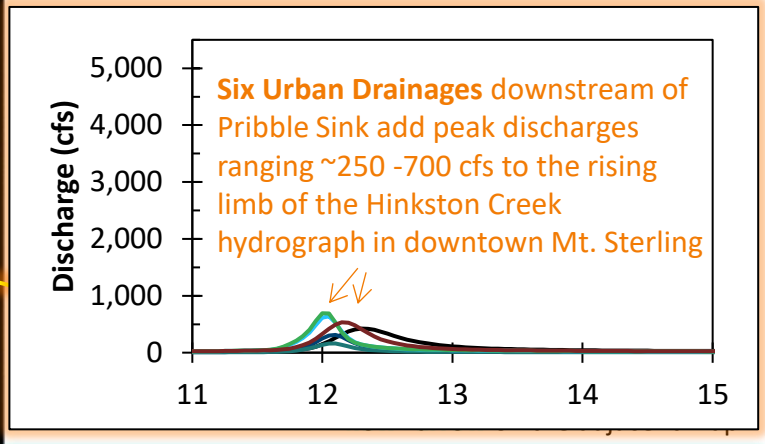
combined benefits of both sinks at the "flow" arrow on the adjacent map

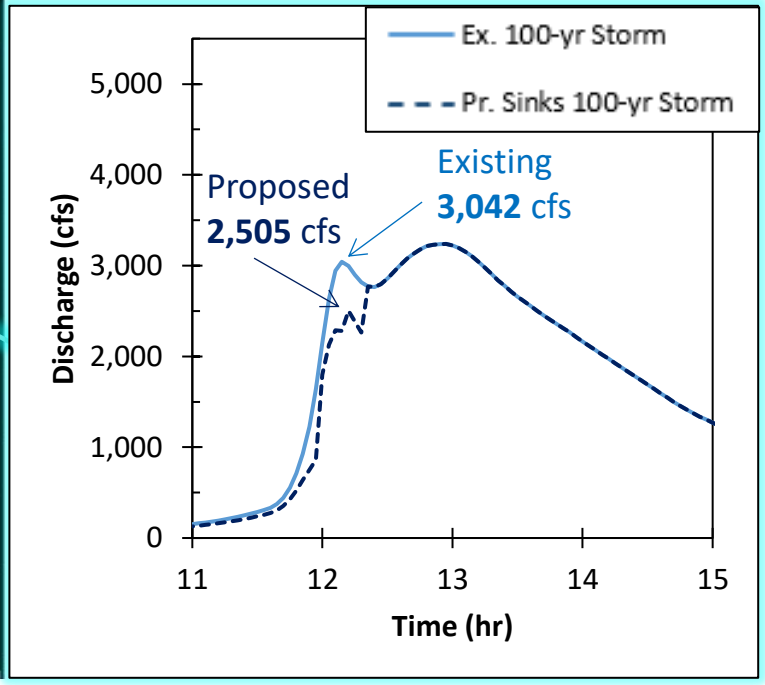


Hydrologic (Sink) Benefits

Urban drainages downstream of Pribble Park add to the rising limb of the 100-yr hydrograph in Hinkston Creek

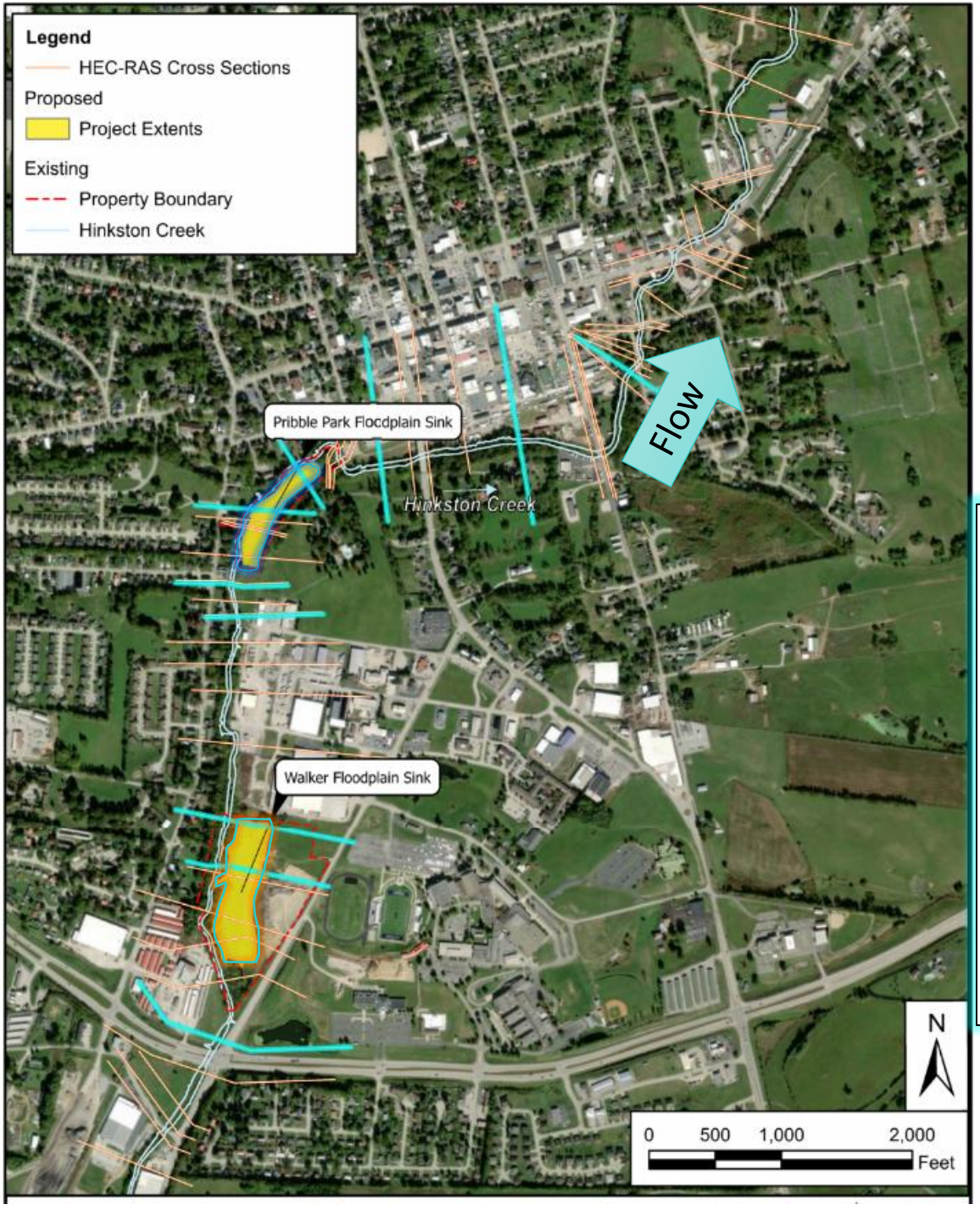


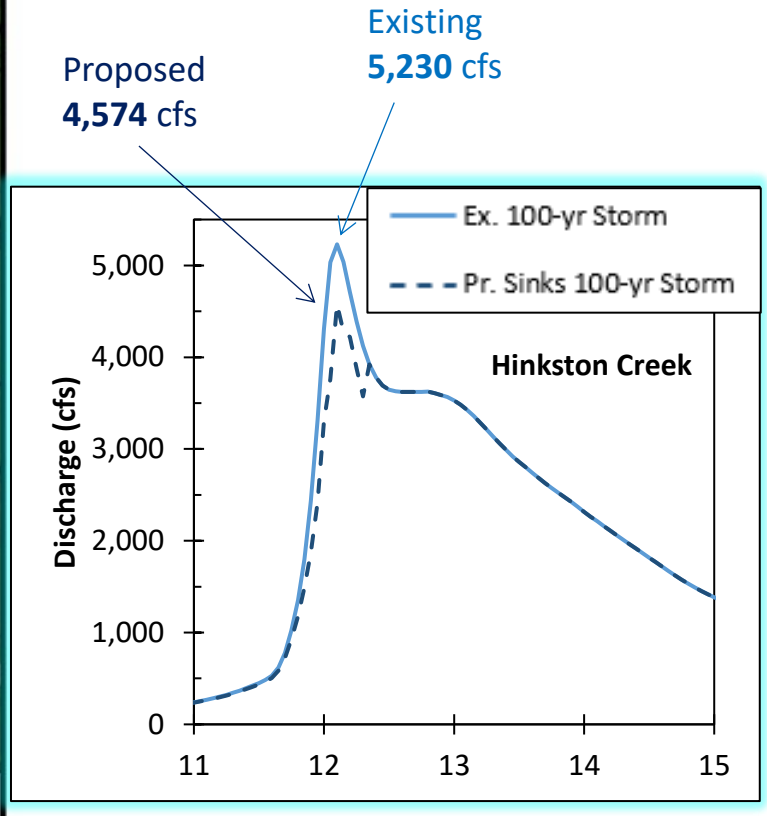




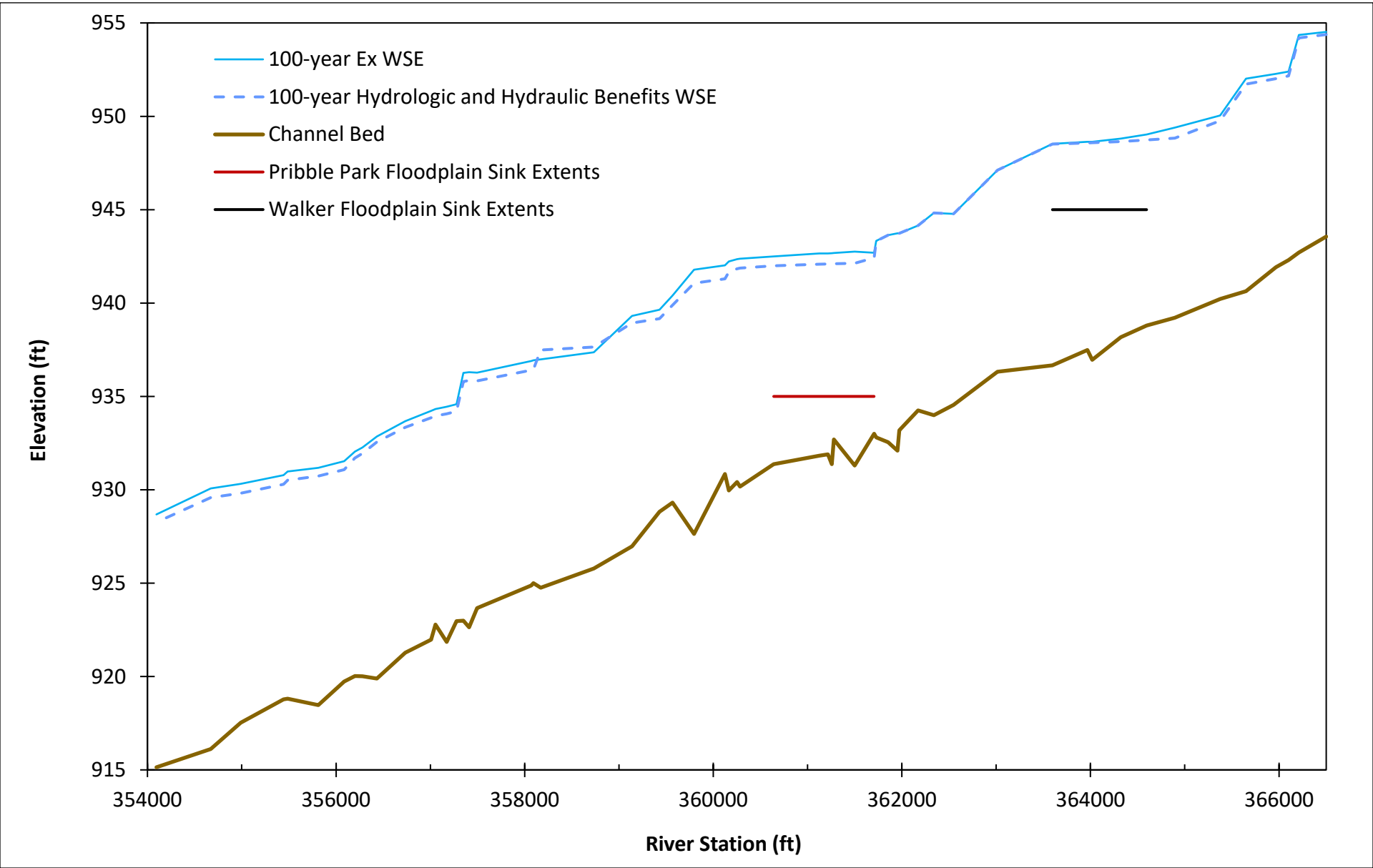
Hydrologic (Sink) Benefits

When combined, both sinks reduce the peak of the 100-year design storm in Hinkston Creek (at the location of the "flow" arrow in the adjacent map) by ~650 cfs



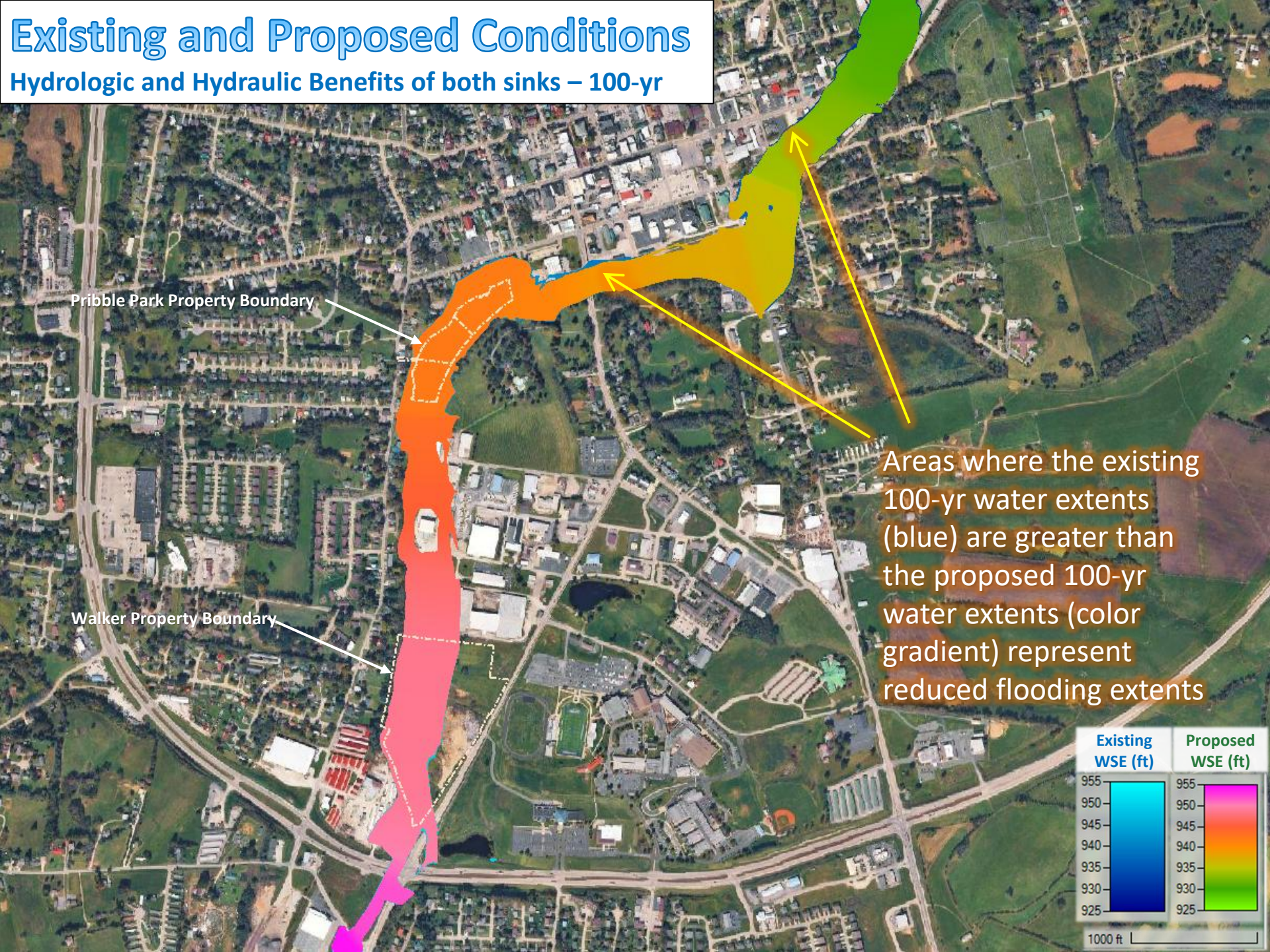


Hydrologic and Hydraulic Flood Reduction Benefits of Two Floodplain Sinks in Mt. Sterling



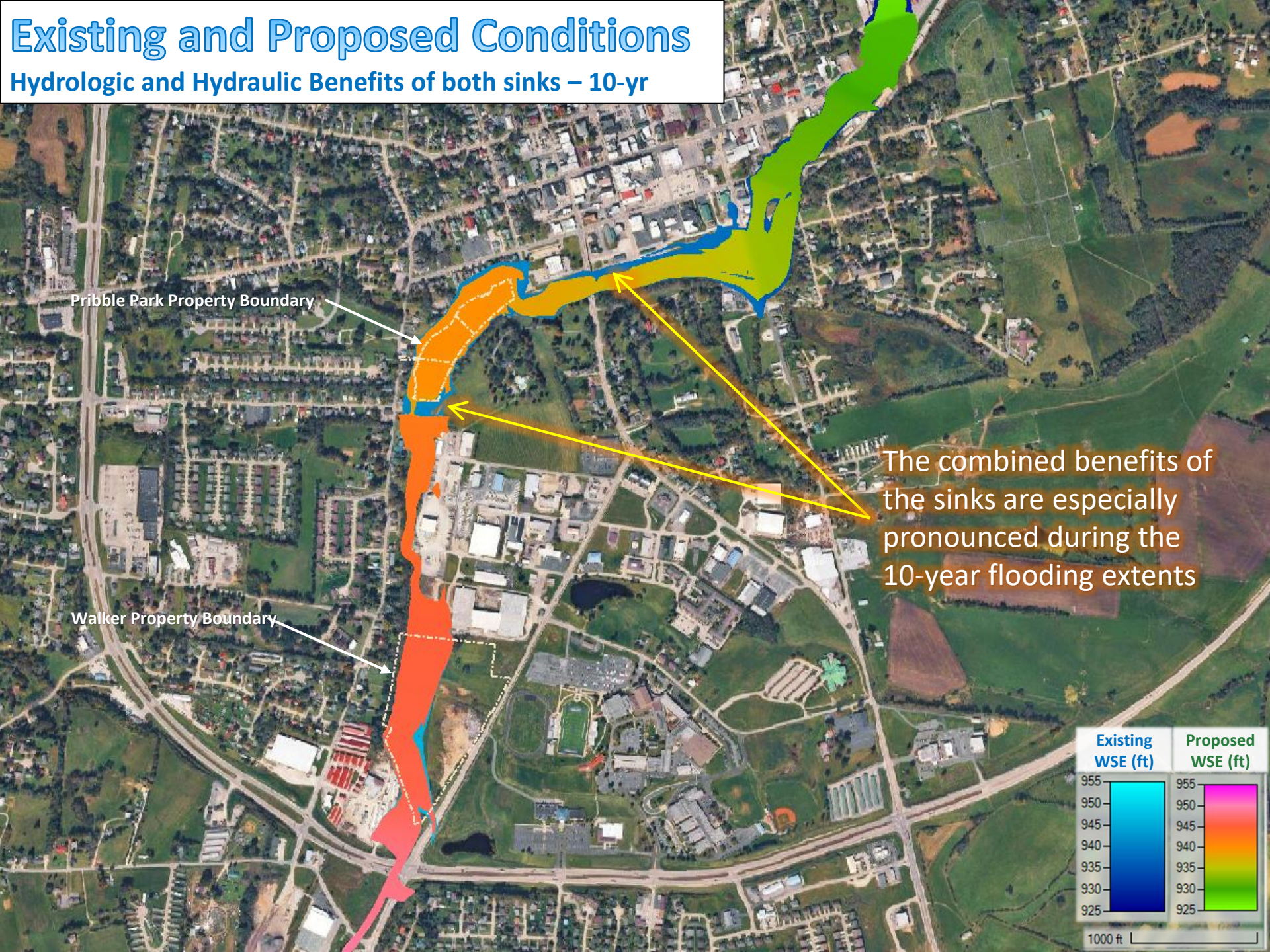
Existing and Proposed Conditions

Hydrologic and Hydraulic Benefits of both sinks – 100-yr



Existing and Proposed Conditions

Hydrologic and Hydraulic Benefits of both sinks – 10-yr



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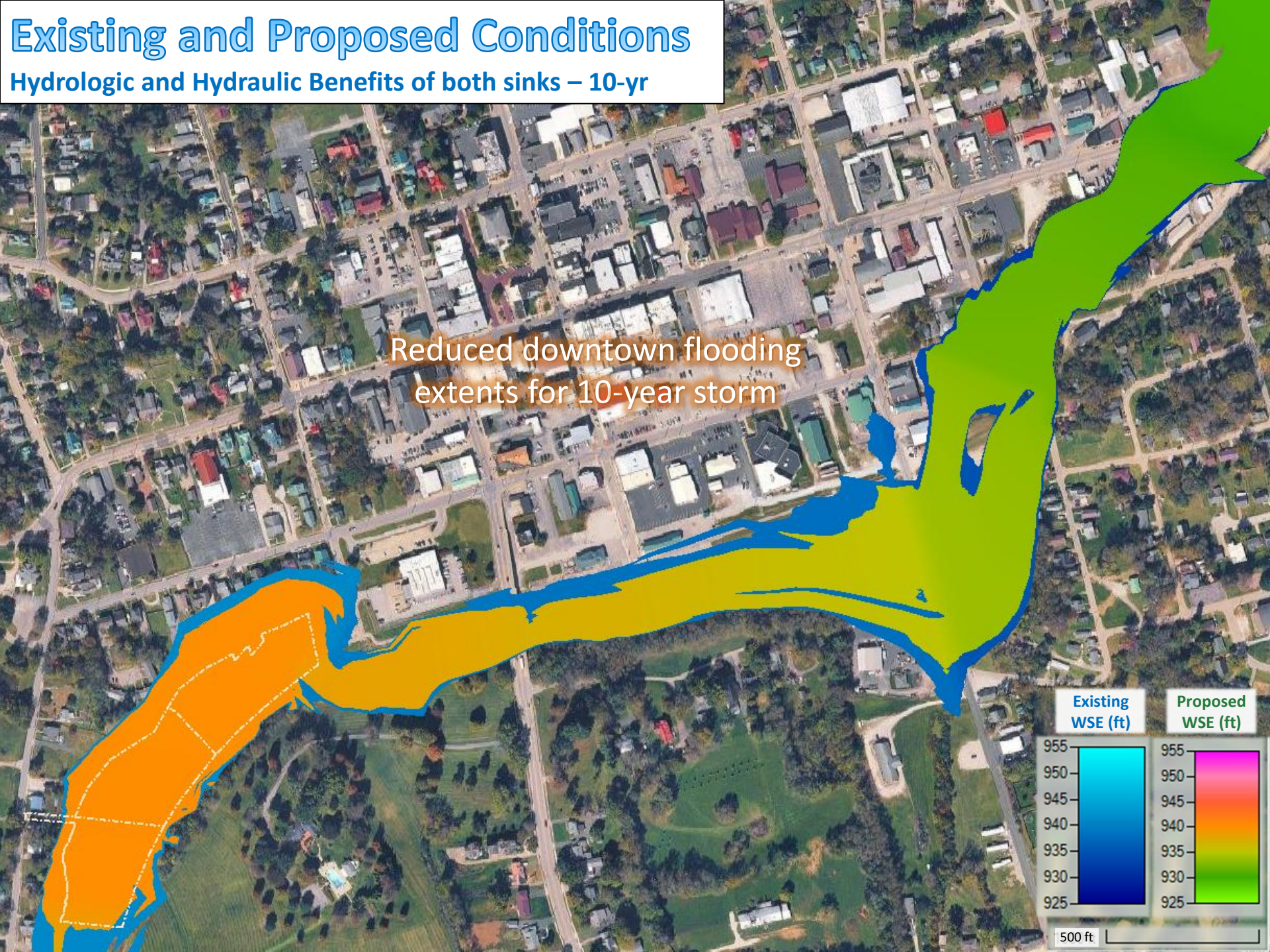
Existing and Proposed Conditions

Hydrologic and Hydraulic Benefits of both sinks – 10-yr



Water Quality Benefits

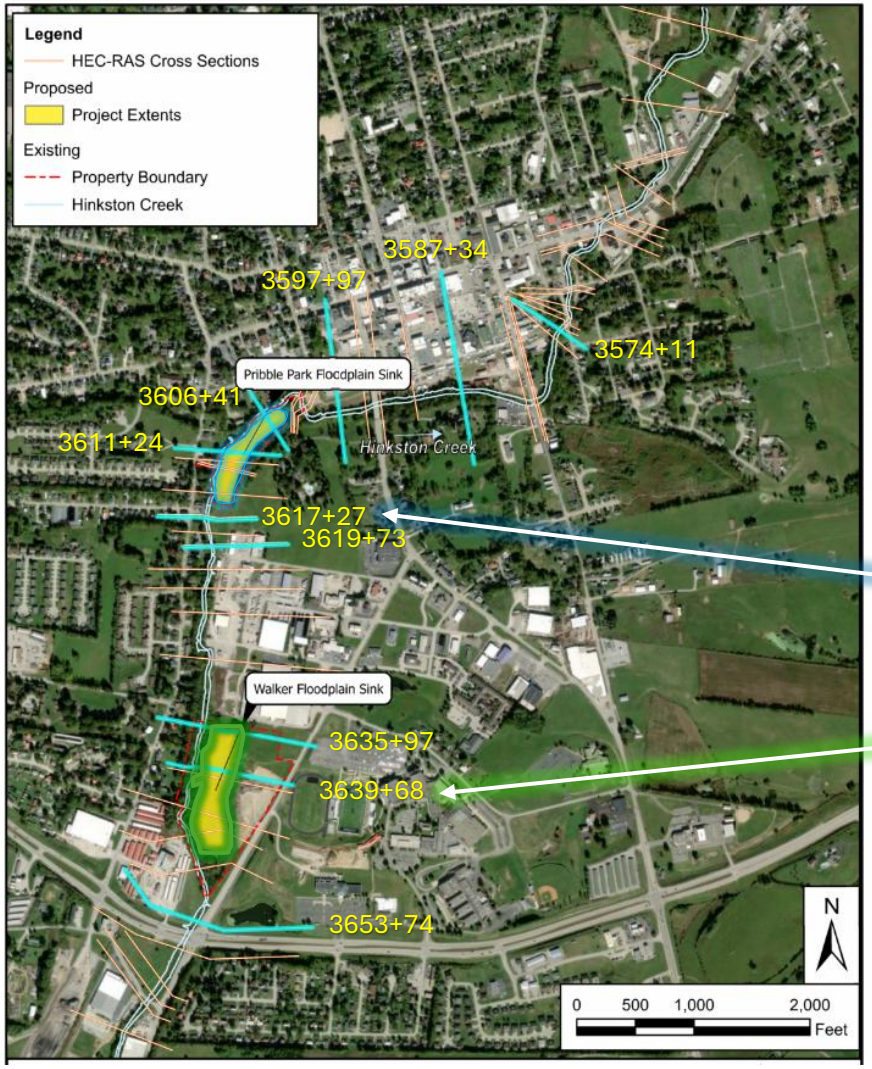
Monitoring of constructed projects by US EPA, USFWS, and partners document large amounts of sediment and nutrient removal

- **Measured** annual pollutant **load reductions** at a 3.7-acre floodplain sink in Williamsburg, OH:
  - **1.3 million pounds of sediment**
  - **3,400 pounds of nitrogen**
  - **1,700 pounds of phosphorus**

Measured removal efficiencies were 54-94%. For more info see: Nietch et al. 2024; Wallentine, 2025; Hawley et al. 2026

Photo of sediment-laden flood flows from the Great Miami River flowing into a floodplain sink near Tipp City, OH

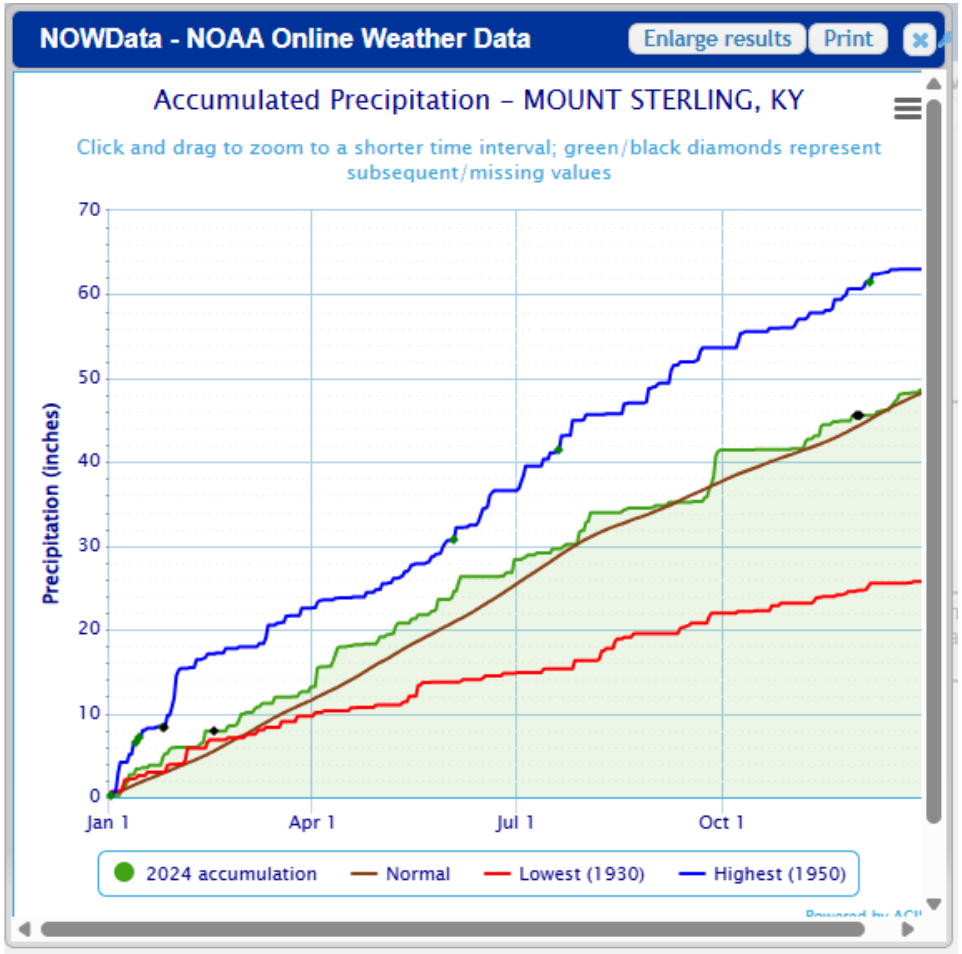
Mt. Sterling's Floodplain Sinks Begin to Offload Flow around ~190 cfs



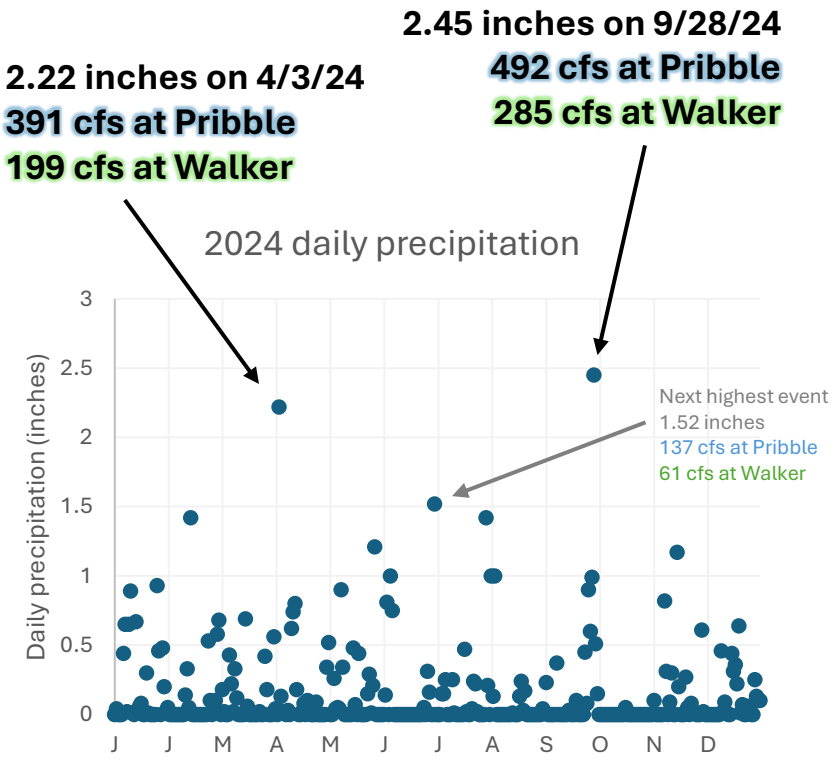
Pribble begins offloading when Q at station 3617+27 is ~190 cfs

Walker begins offloading when Q at station 3639+68 is ~190 cfs

NOAA's Mt. Sterling Rain Gage documented 2024 as a representative ("normal") precipitation year



- In 2024, two events would have offloaded flow into the sinks, conveying 0 to 46% of the total conveyance over the sinks

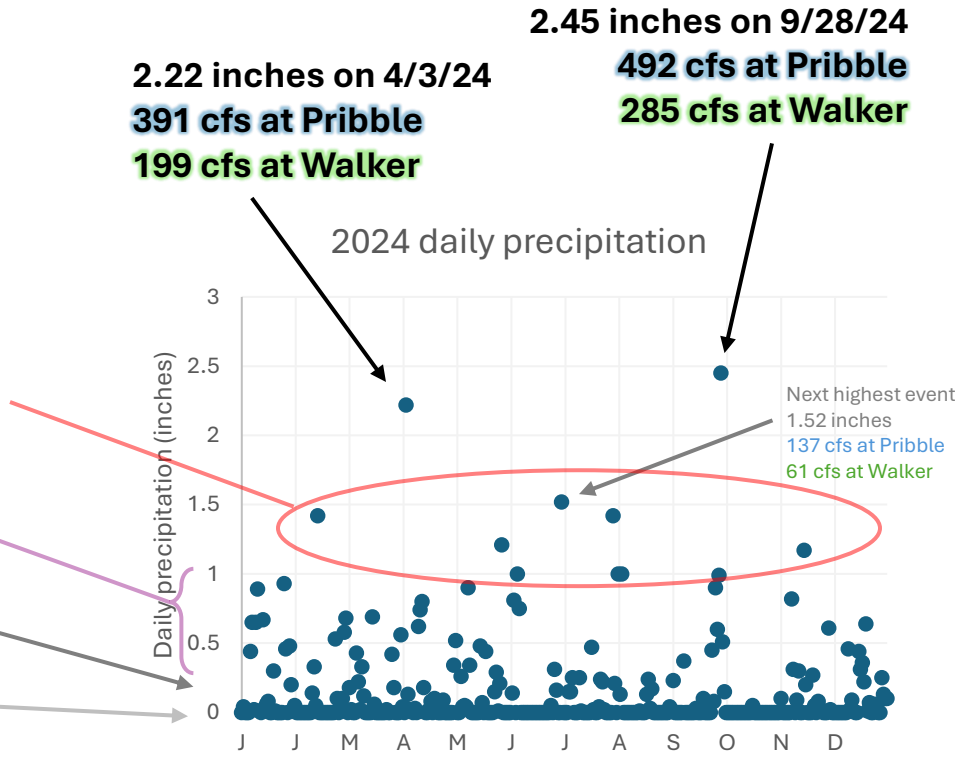


A Large Portion of the Annual Pollutant Load Occurs during the Highest Discharges

- Conservative to assume the two largest events account for ~half of the annual loads that occur during high flows.
- Given that high flows account for ~90-95% of the total annual load[(1)], these two largest events could account for ~45% of the total annual load.

Rationale:

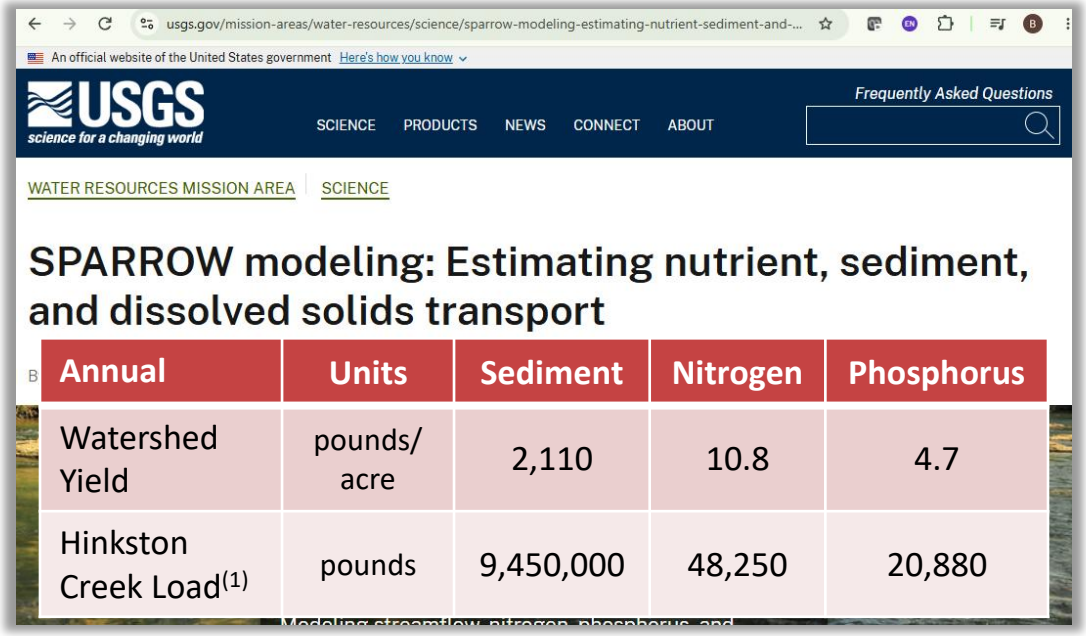
- Two largest events (2.22 and 2.45 inches) produce peak discharges that are ~3-4x larger than the next highest event (1.52 inches).
- Combined hydrograph volume of the two largest events (251 acre-feet) is more than 2x the combined volume of the next 8 highest events (1 to 1.52 inch events combine to create 116 acre-feet of hydrograph volume).
- 50 events 0.25 to 1 inches (medium/low events) would be unlikely to account for more than ~5-10% of the total annual load[(1)]
- 35 events 0.1 to 0.25 inches would be unlikely to generate appreciable runoff
- 50 events 0.01 to 0.1 inches unlikely to generate any runoff



[(1)]Based on load duration analysis In a mixed use agricultural/rural/developed watersheds similar to Hinkston Creek, ~90-95% of the total annual load occurs during high flows (see UT ALF0.2, Appendix 4-E, page 4-E-17 of Woolper Creek Watershed Plan (2016).

Mt. Sterling Load Reduction Estimates

Absent site-specific monitoring, site-specific H/H modeling combined with watershed yields from the USGS SPARROW model can be used to project load-reduction estimates for the proposed floodplain sinks in Mt. Sterling, KY



Annual	Units	Sediment	Nitrogen	Phosphorus
Watershed Yield	pounds/ acre	2,110	10.8	4.7
Hinkston Creek Load(1)	pounds	9,450,000	48,250	20,880

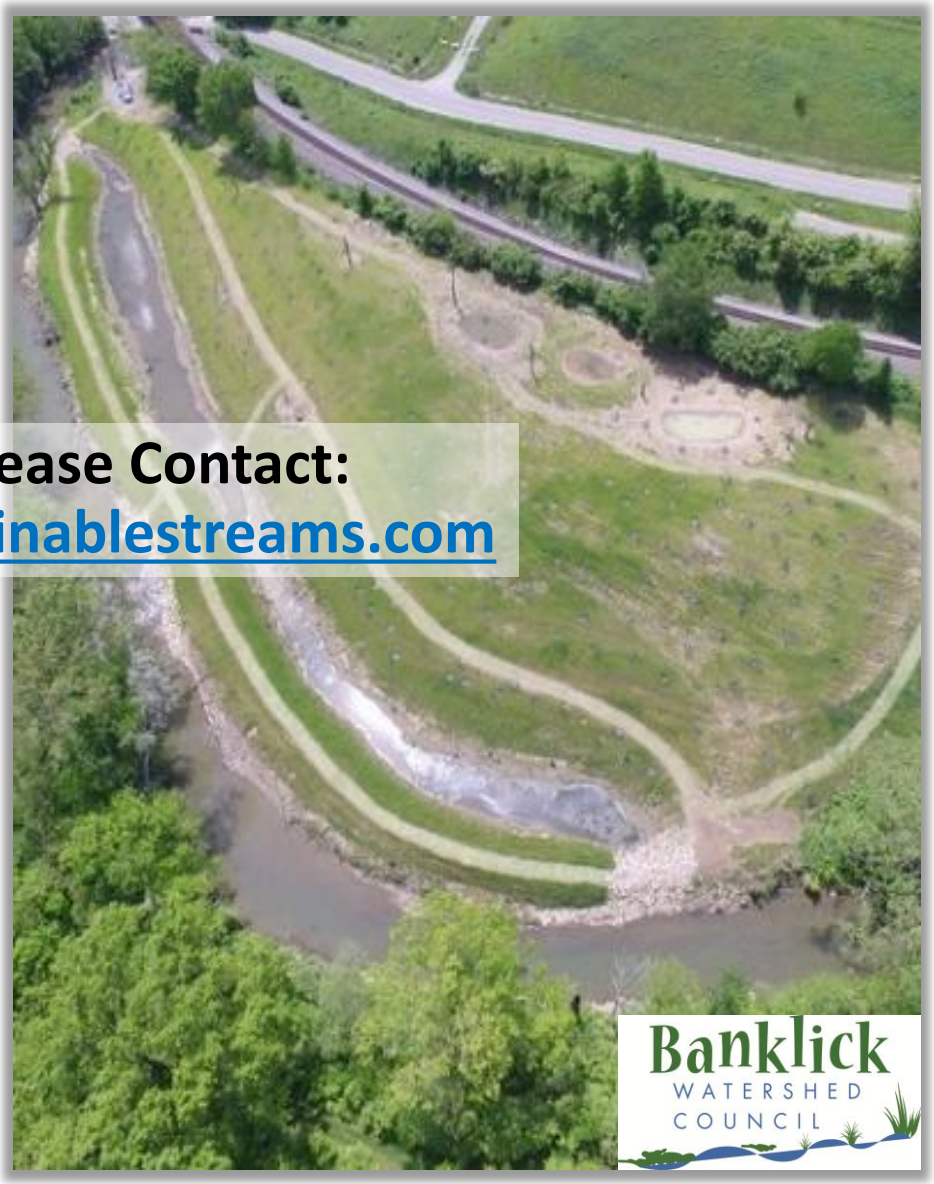
(1)Based on a drainage area of 7 mi²

Annual Load Reduction Estimates(2)

Site	Sink Area	Sink Volume	Offloading Threshold	Events offloaded in representative year (2024)	E. coli	Sediment	Nitrogen	Phosphorus
	acre	*acre-ft*	*%Q_2*		*colonies*	*pounds*	*pounds*	*pounds*
Pribble	3.0	8.8	25%	2	55 billion	83,000	440	190
Walker	5.9	24.1	35%	2	151 billion	225,000	1,190	510
Total	**8.9**	**32.9**			**206 billion**	**308,000**	**1,630**	**700**

(2)Hydraulic modeling shows increasing flow conveyance over the sinks as discharge increases (~0% at connection elevation, 40-55% of total conveyance at Q_2, ~70-80% of total conveyance at Q_{100}. Sediment and nutrient load reduction estimates for events that flow over the Mt. Sterling sinks assume that just 45% of the annual loads occur during high flows when the sinks are engaged, just 20% of the load during high flows is flowing over the sinks, and a removal efficiency of just 25% (e.g., total sink load reductions during flow over events are 0.45 x 0.2 x 0.25 = 2.25% of total annual load in Hinkston Creek). Additional load reductions account for the water that gets trapped in the sink, with average high flow concentrations from UT ALF0.2 from Woolper Creek Watershed Plan, Appendix 4-E, page 4-E-13 through 15; PDF pages 130 - 132): 254 col/100mL of E.coli, 5.88 mg/L of TSS, 0.62 mg/L of TN, 0.22 mg/L of TP, scaled by the ratios between the total watershed yields between UT ALF0.2 and the SPARROW model estimates for Hinkston Creek resulting in concentrations of 532 mg/L of TSS, 3.04 mg/L of TN, and 1.28 mg/L of TP for the inflows into the Mt. Sterling Sinks. E.coli load reductions assume a high flow concentration of 254 col/100mL and that only the water stored within the sink during the event removes E.coli.

Special thanks to KDOW for funding the design and modeling of the Mt. Sterling floodplain sinks, along with the design and construction of several other sinks in KY



Questions? Please Contact:
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Boone County Conservation District, Kentucky

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