APPENDIX A

Yellow Creek Watershed Maps

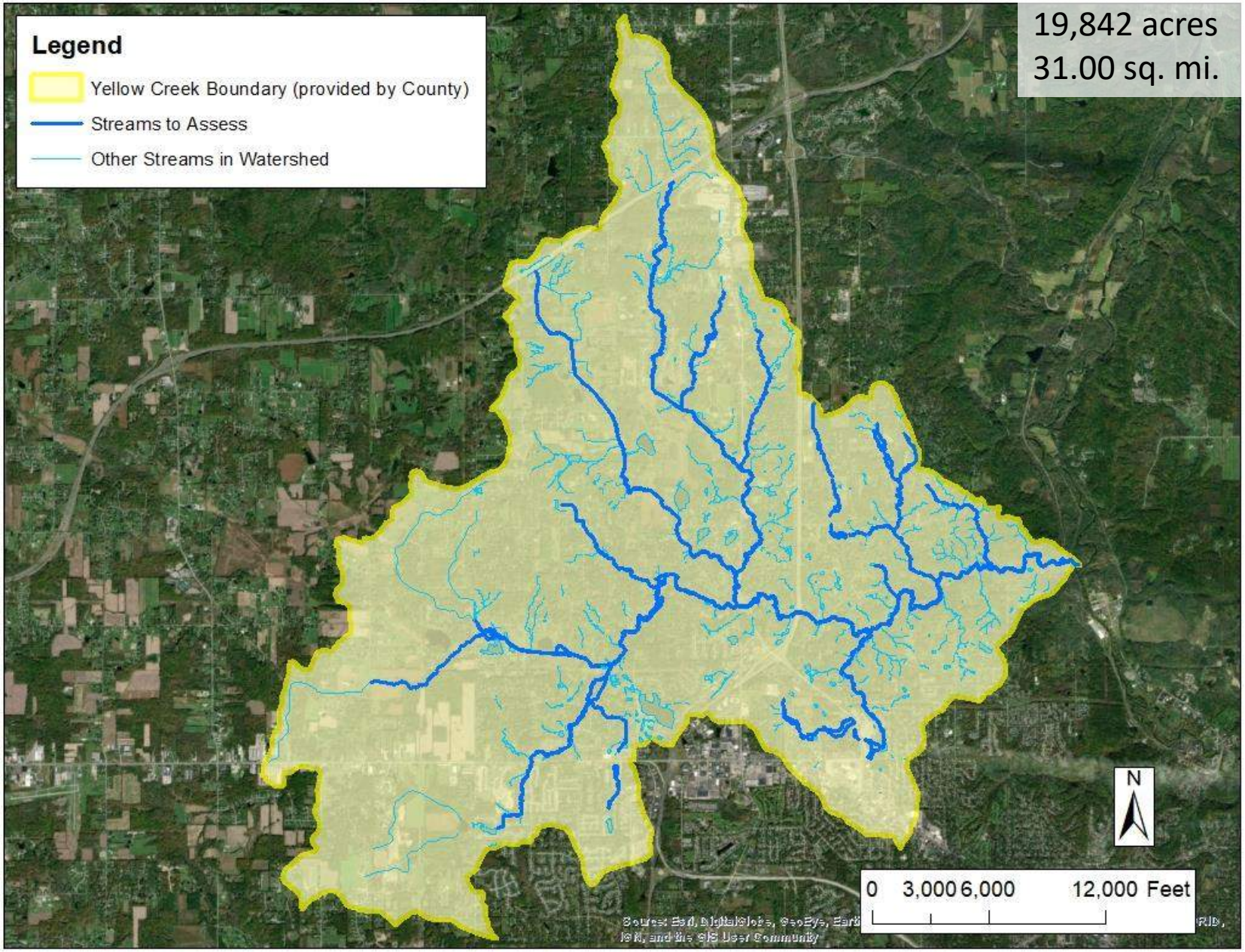


Figure A1. Yellow Creek Watershed boundary provided by the County

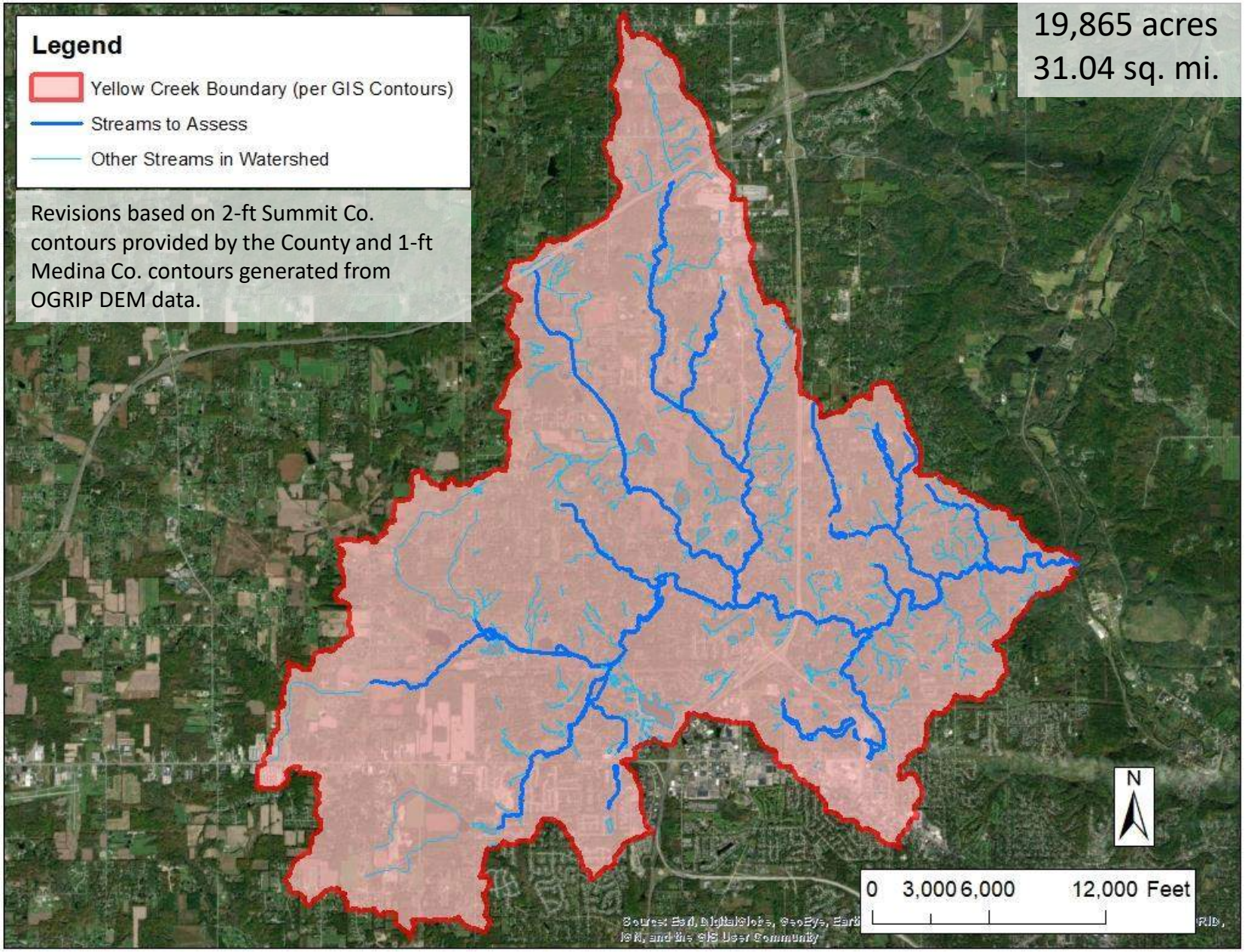


Figure A2. Yellow Creek Watershed boundary delineated per GIS contours

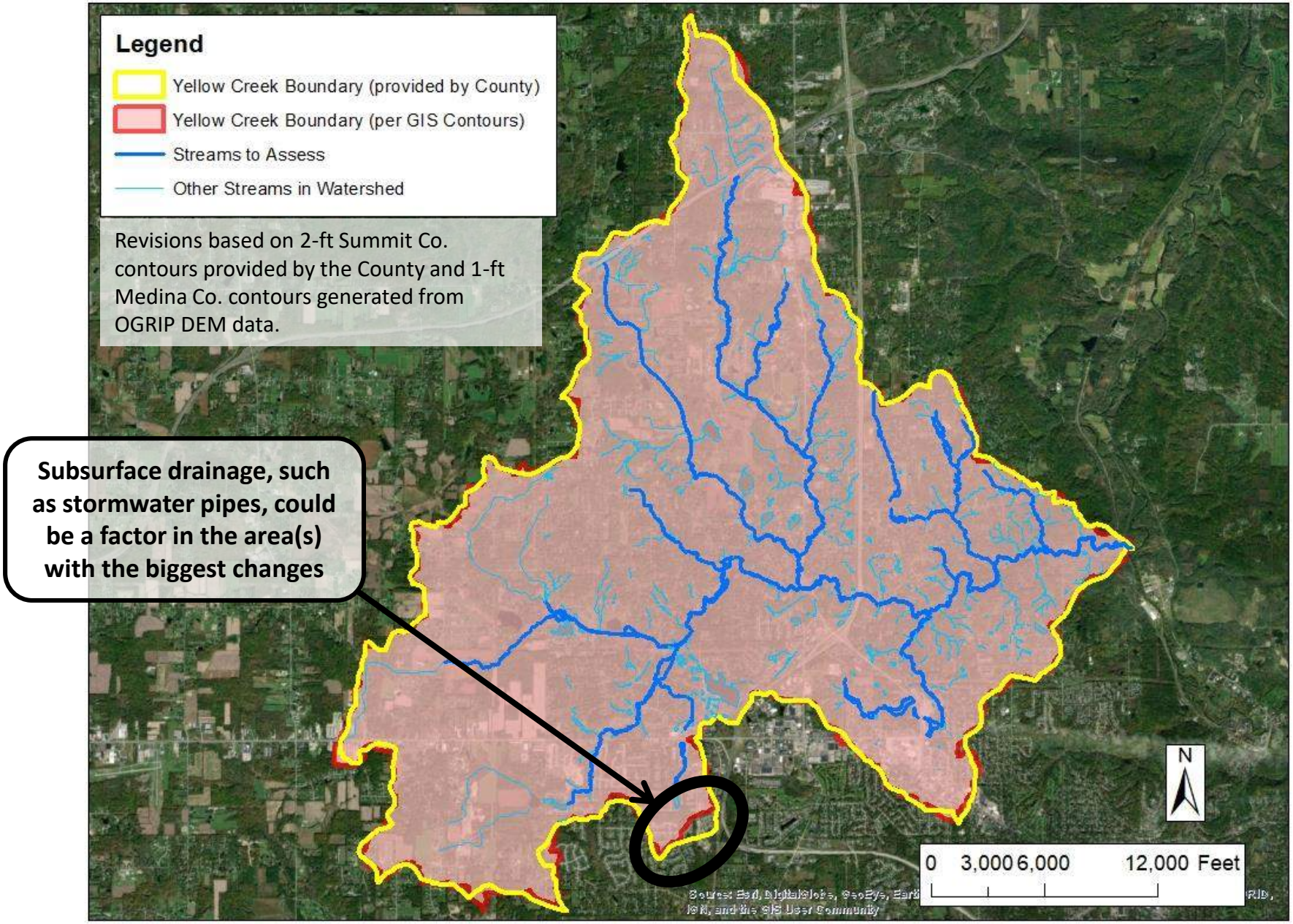


Figure A3. Yellow Creek Watershed boundary comparison

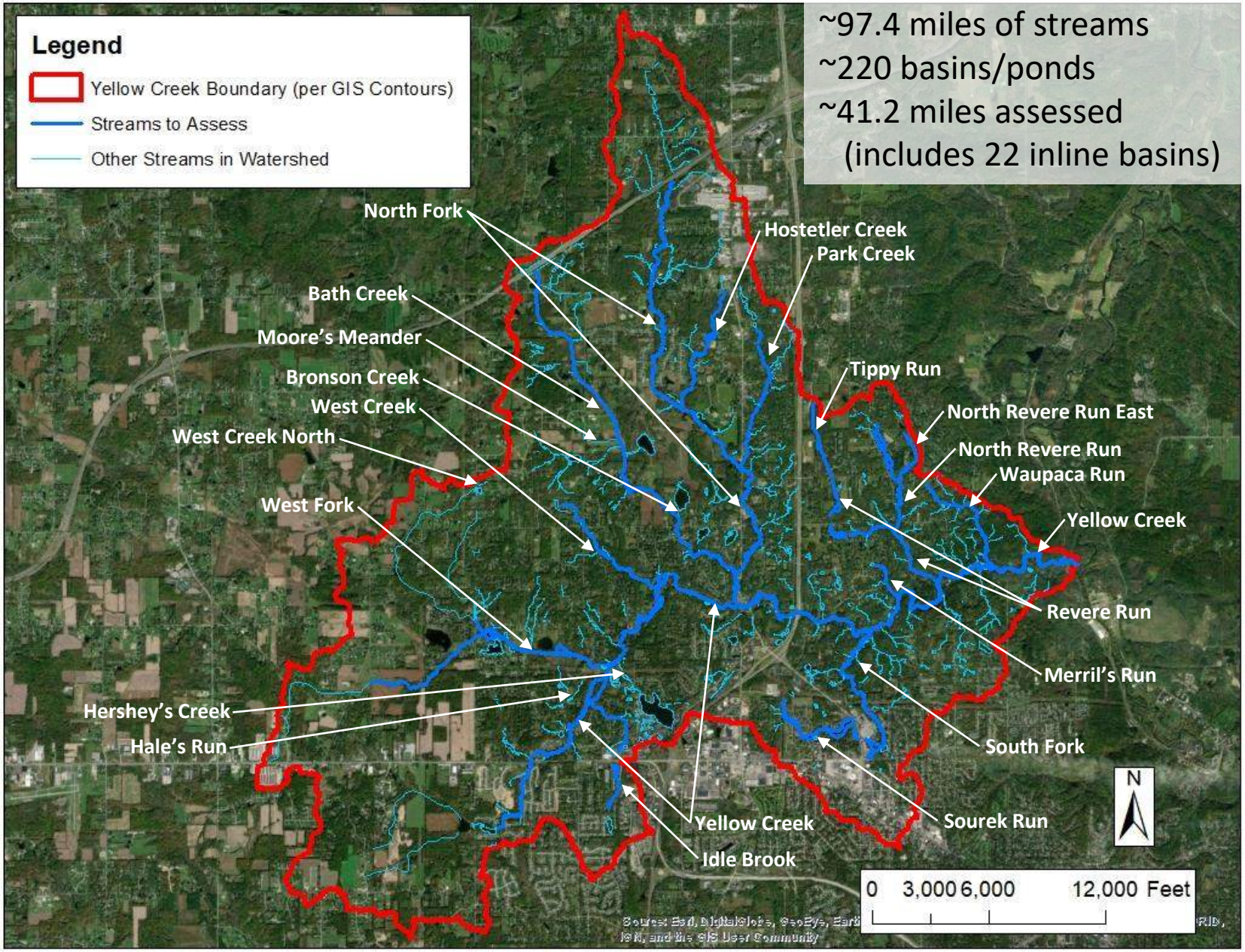


Figure A4. Streams in the Yellow Creek Watershed

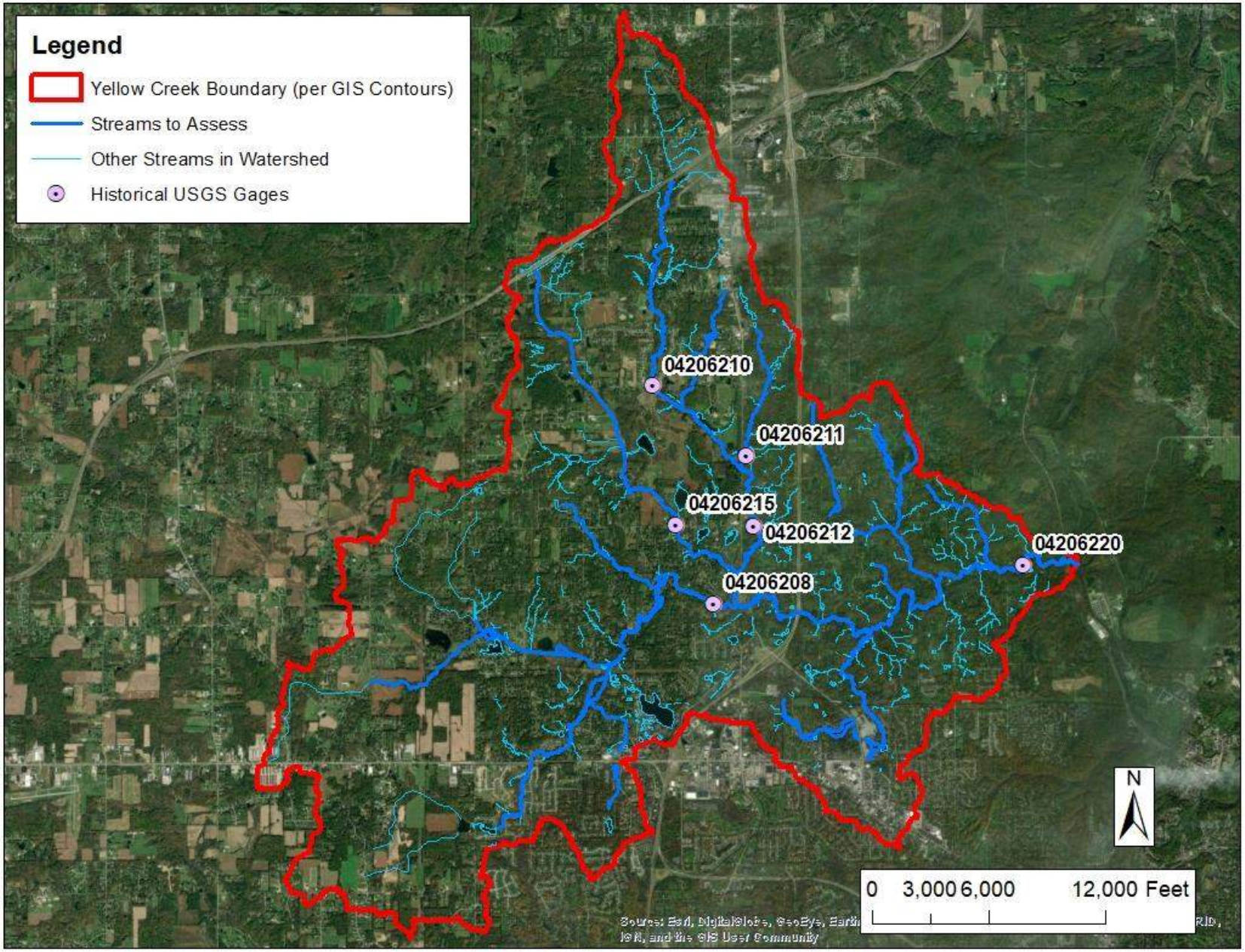


Figure A5. Historical USGS gages in the watershed

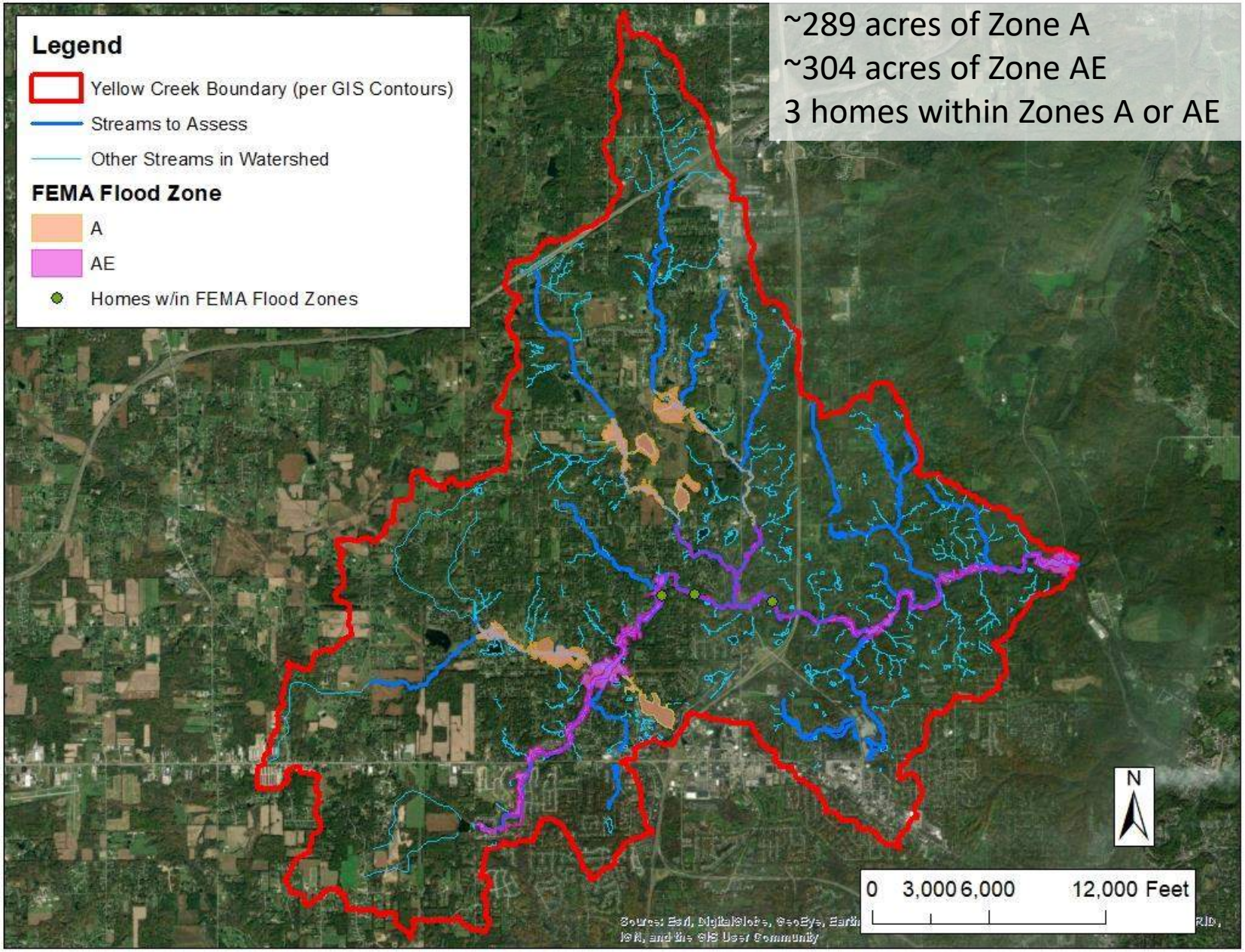


Figure A6. FEMA Flood Zones and Homes within Flood Zones within the watershed

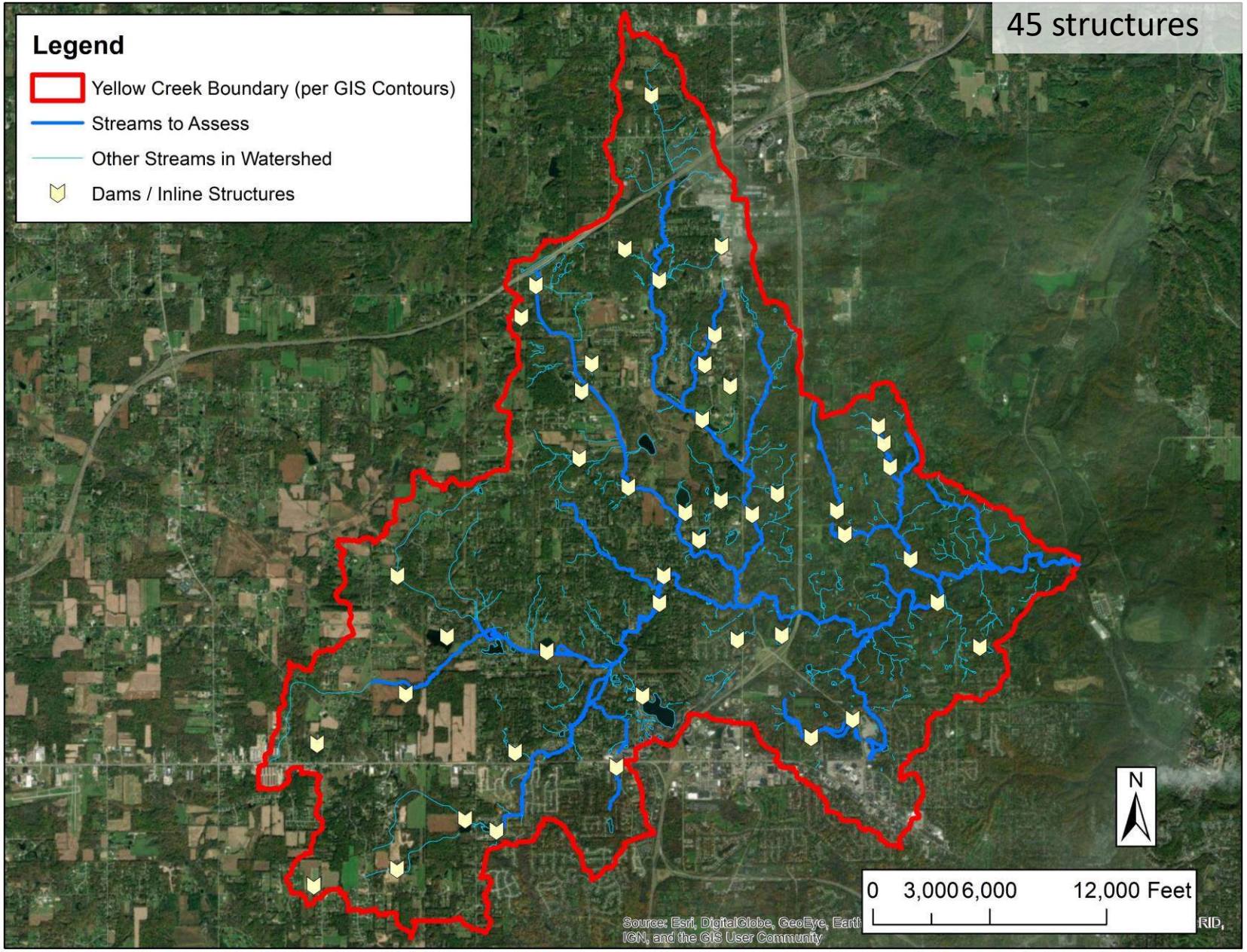


Figure A7. Dams and inline structures in the Yellow Creek Watershed

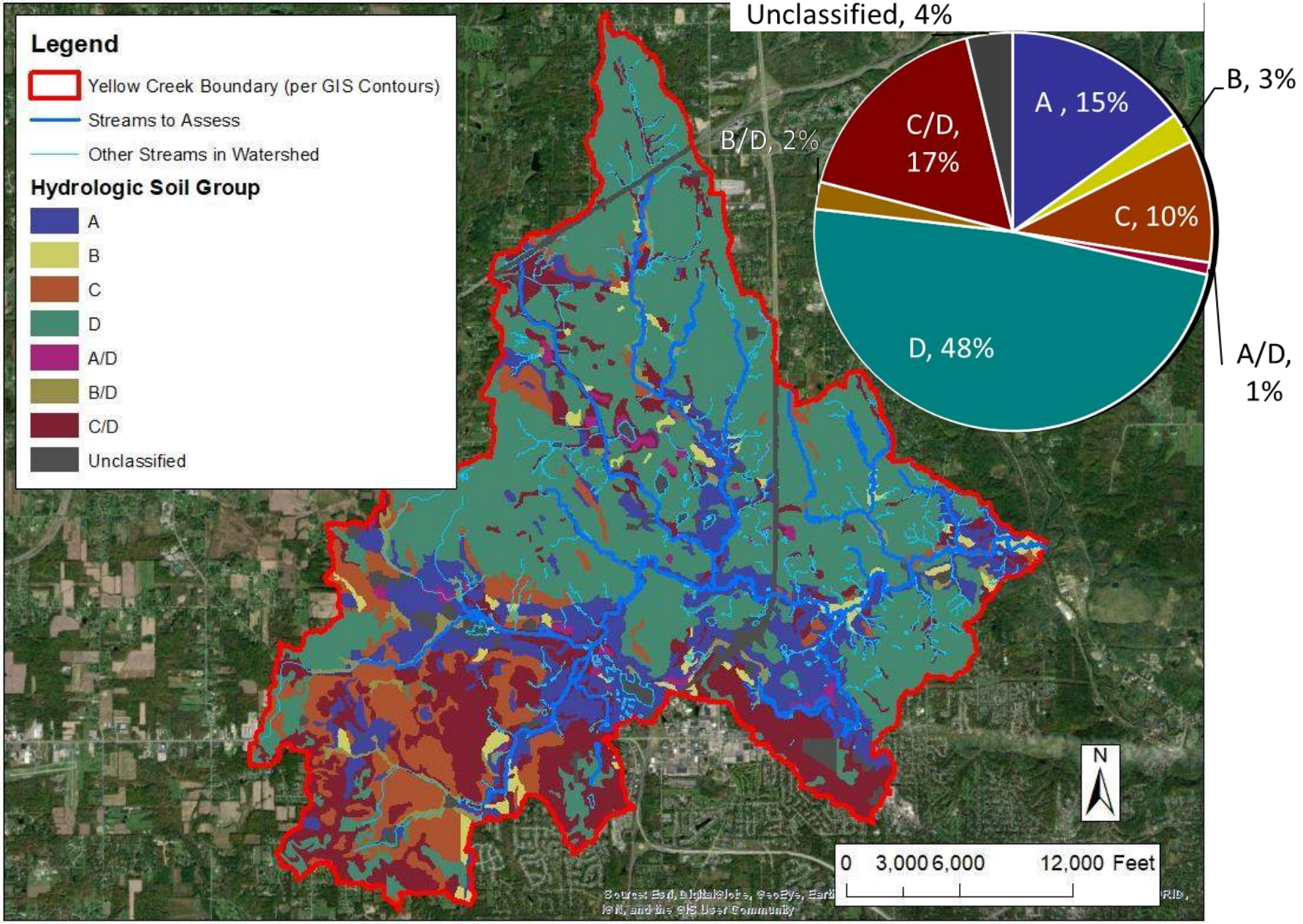


Figure A8. Soils by hydrologic soil group in the Yellow Creek Watershed

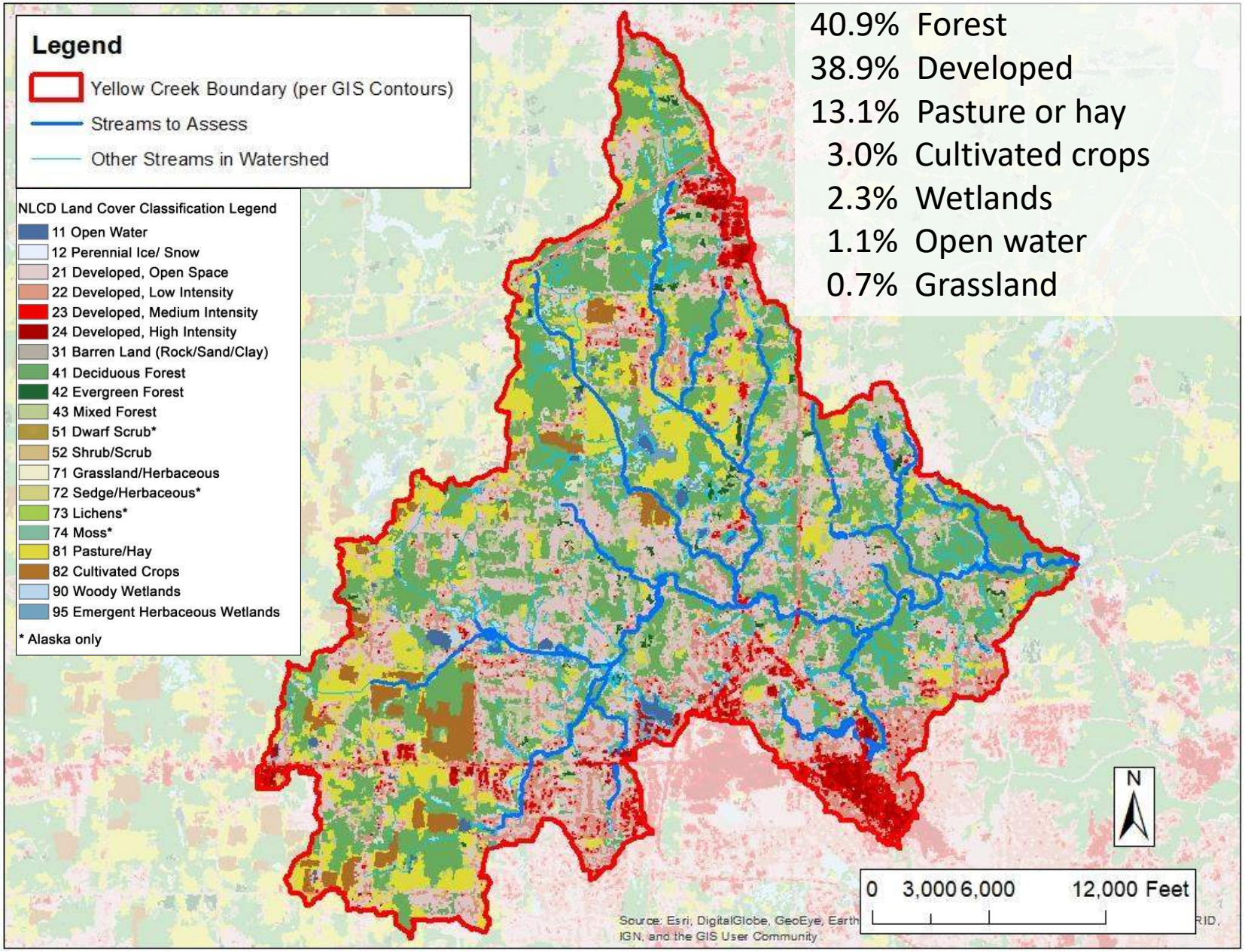


Figure A9. Land cover in the watershed per NLCD 2016 data

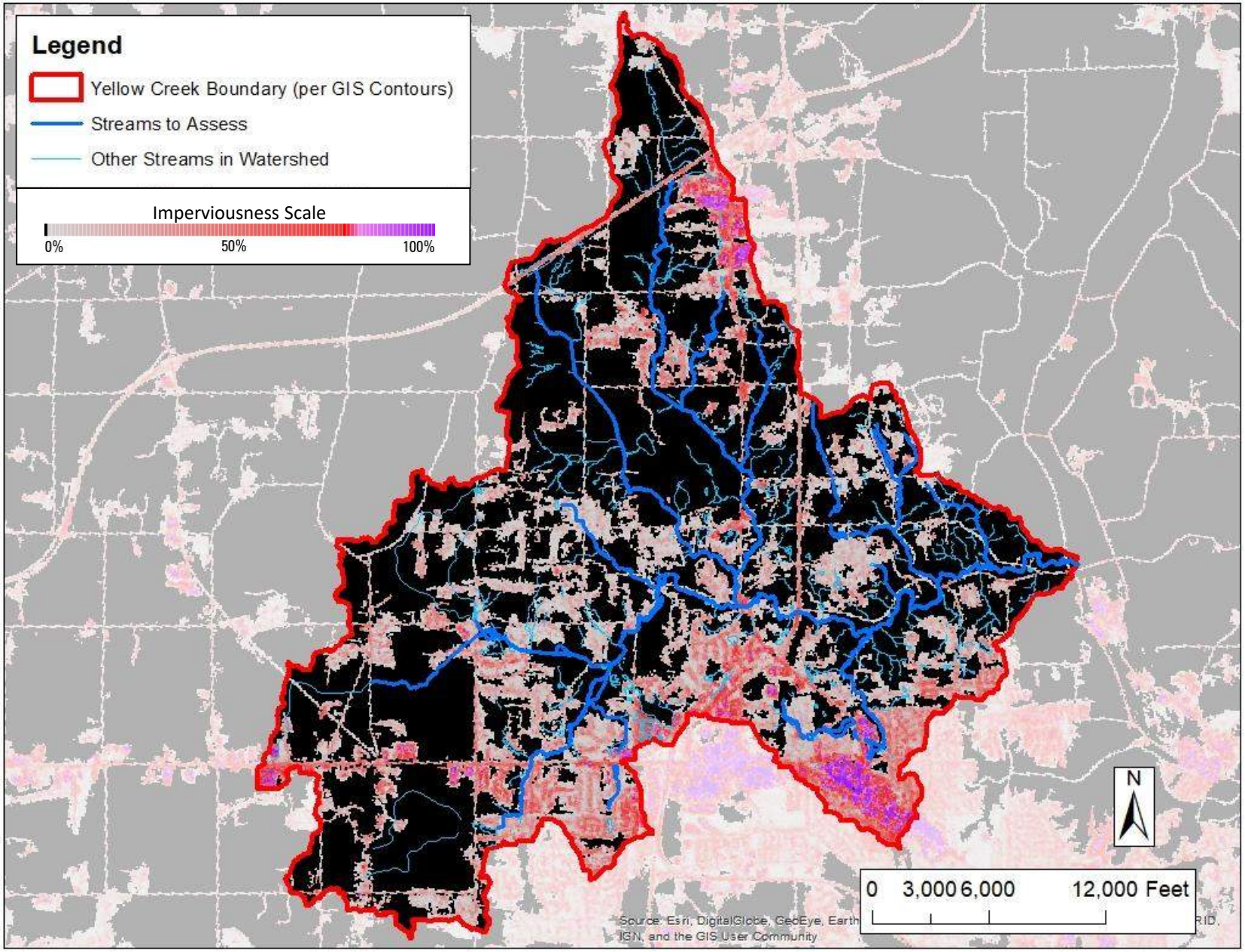


Figure A10. Imperviousness in the watershed per NLCD 2016 data

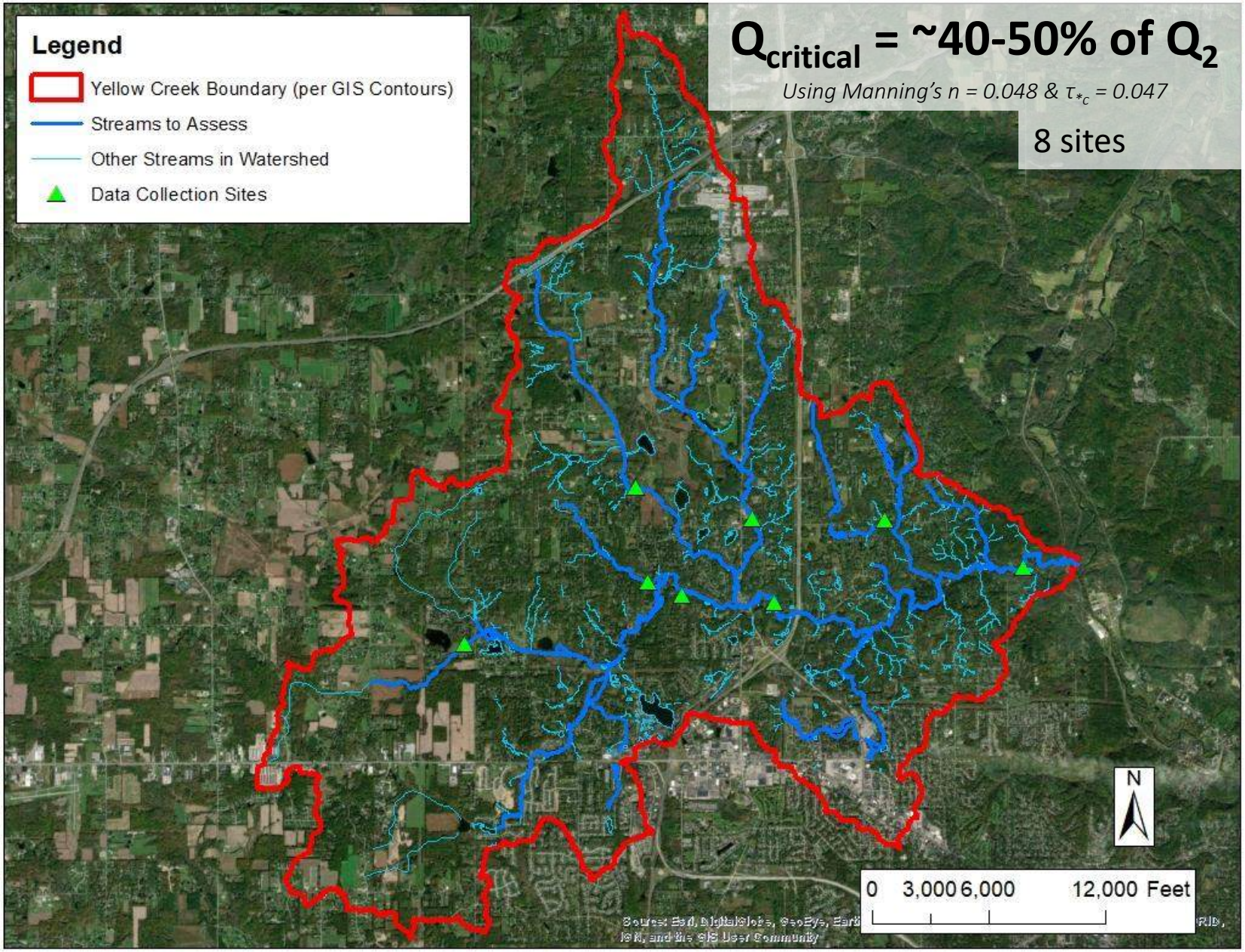


Figure A11. Hydrogeomorphic survey locations in the Yellow Creek Watershed

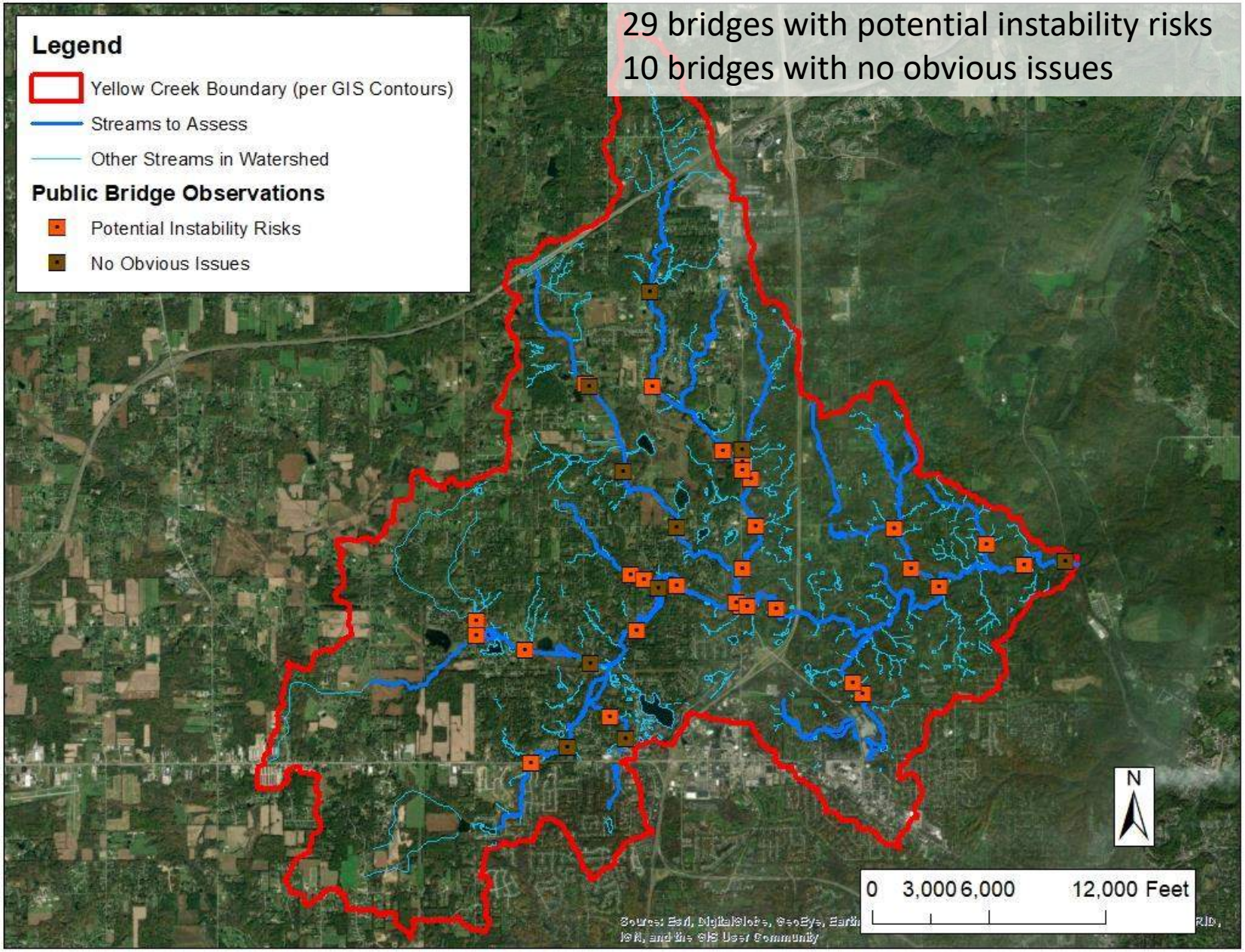


Figure A12. Public bridge observations

Note: This is not an exhaustive list of every bridge in the watershed. Additionally, these assessments were not structural assessments by structural engineers, but rather assessments of stream stability at stream structures conducted by stream experts.

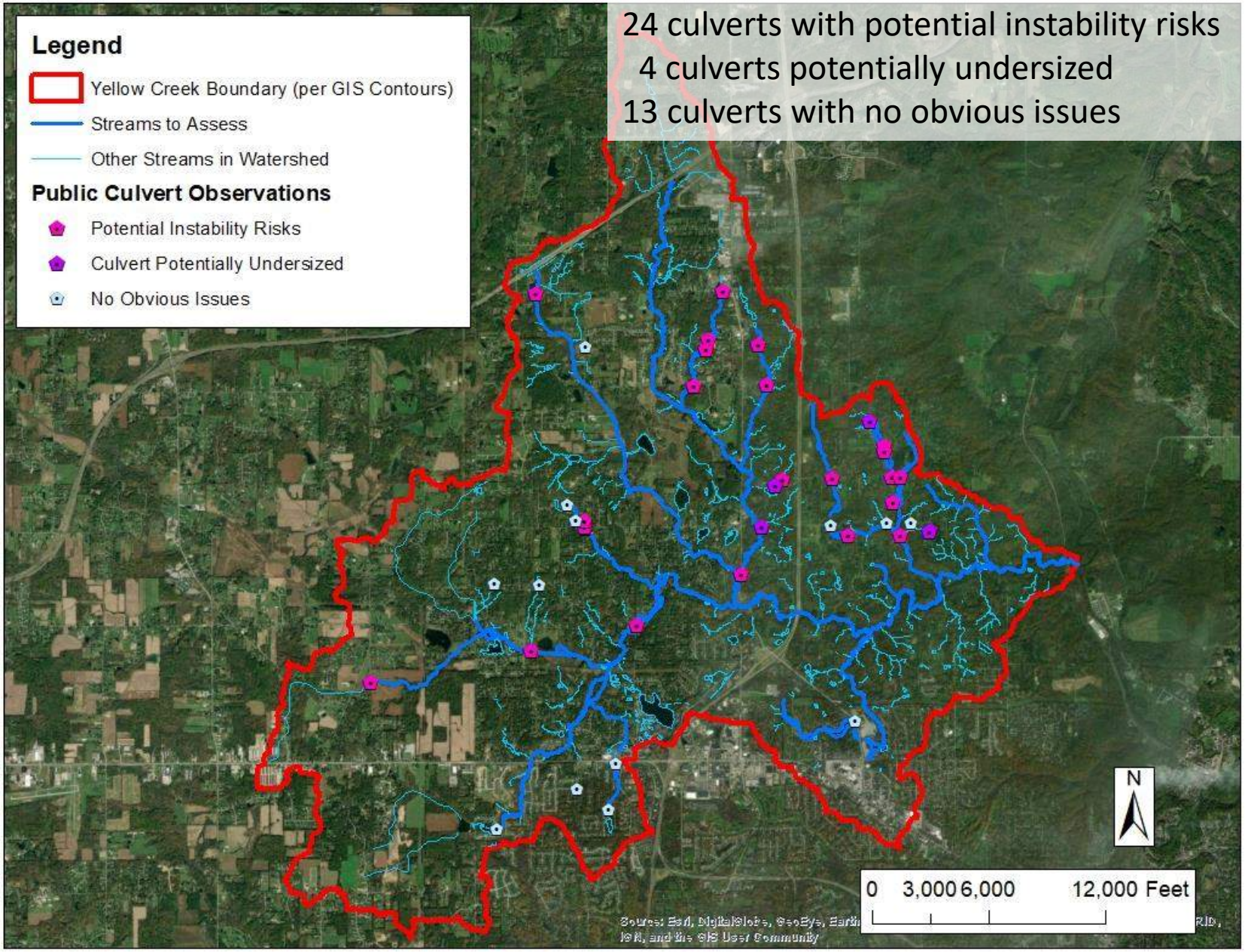


Figure A13. Public culvert observations

Note: This is not an exhaustive list of every culvert in the watershed. Additionally, these assessments were not structural assessments by structural engineers, but rather assessments of stream stability at stream structures conducted by stream experts.

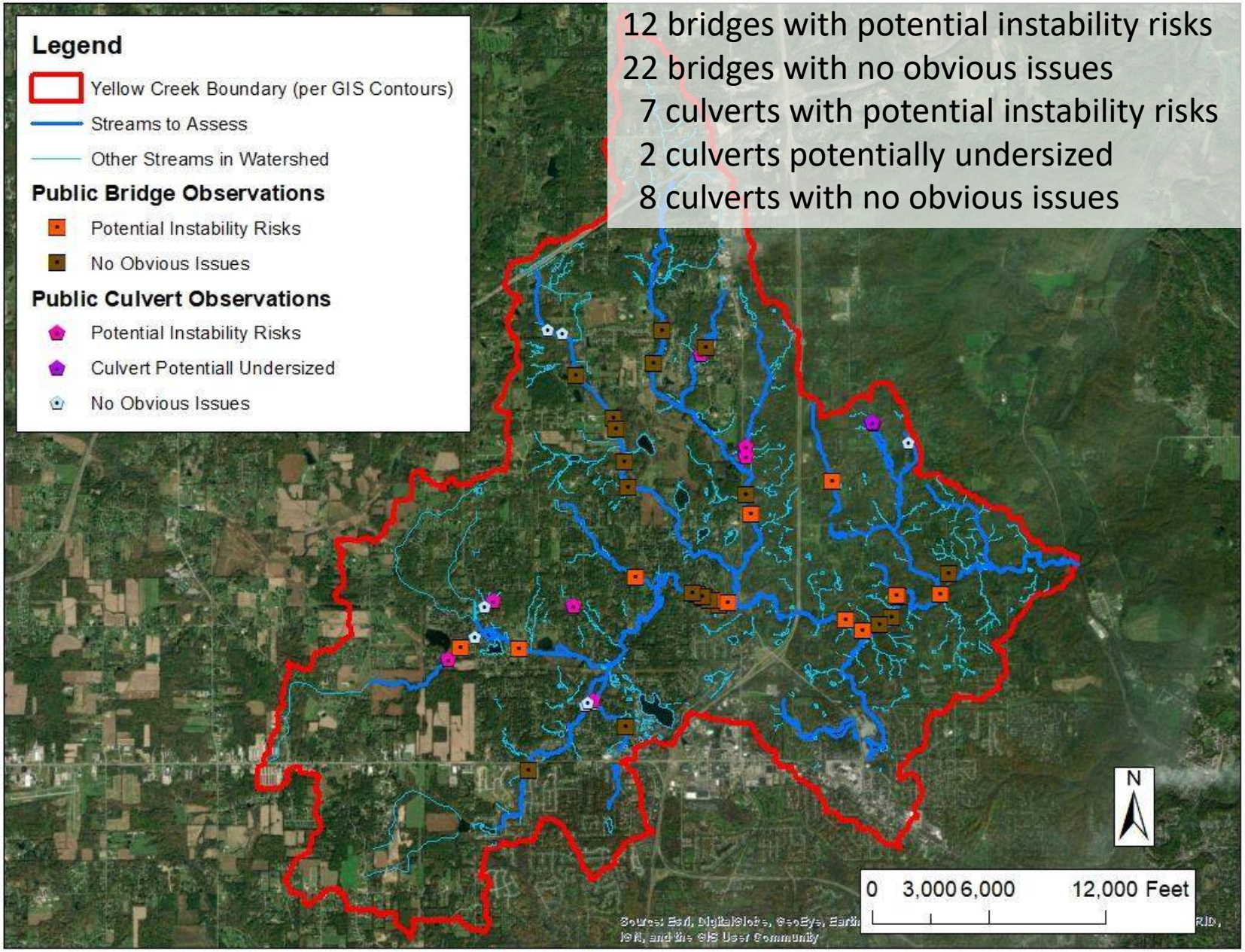


Figure A14. Private bridge and culvert observations

Note: This is not an exhaustive list of every private bridge and culvert in the watershed. Additionally, these assessments were not structural assessments by structural engineers, but rather assessments of stream stability at stream structures conducted by stream experts.

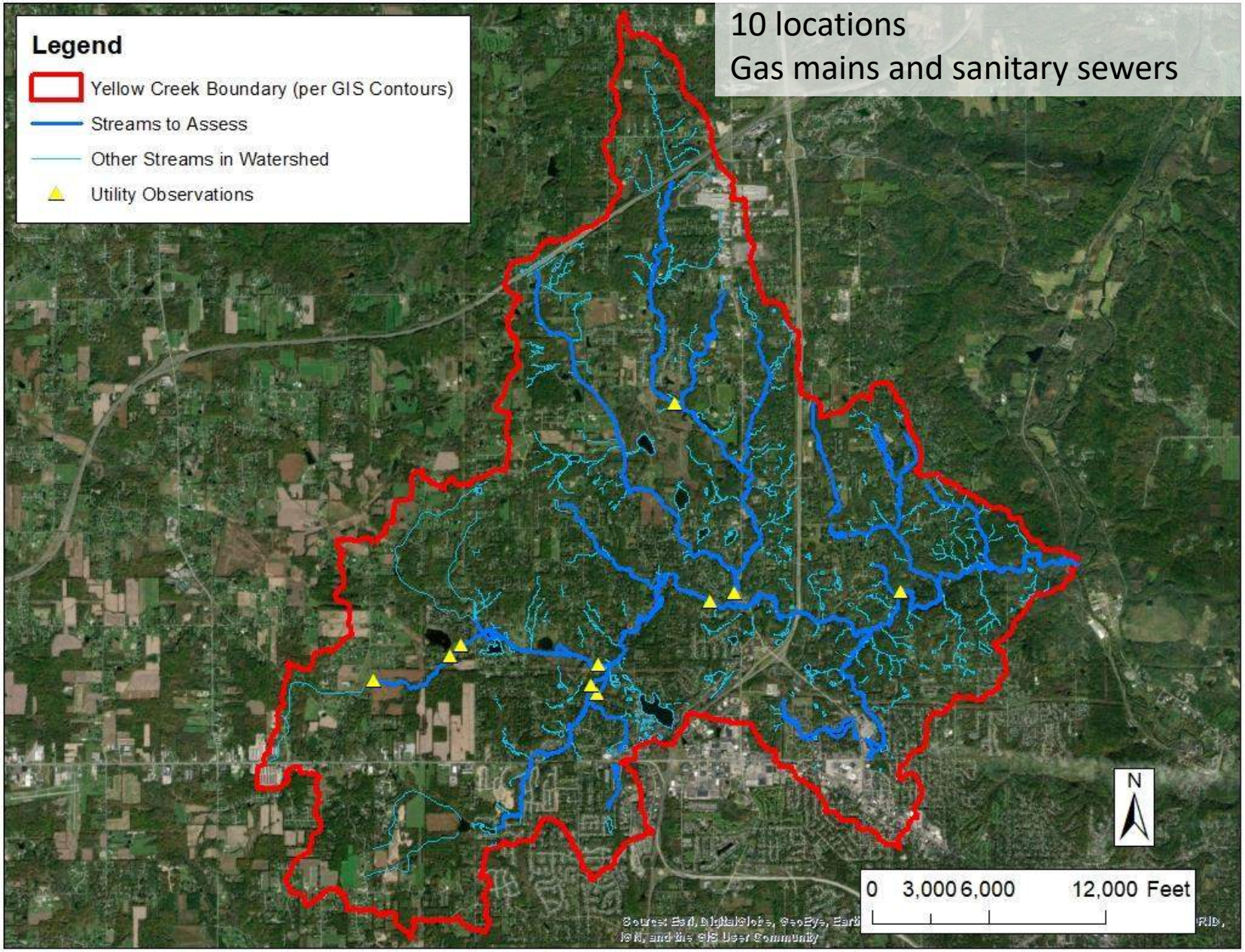


Figure A15. Utility observations
Note: This is not an exhaustive list of utilities in the vicinity of streams in the watershed.

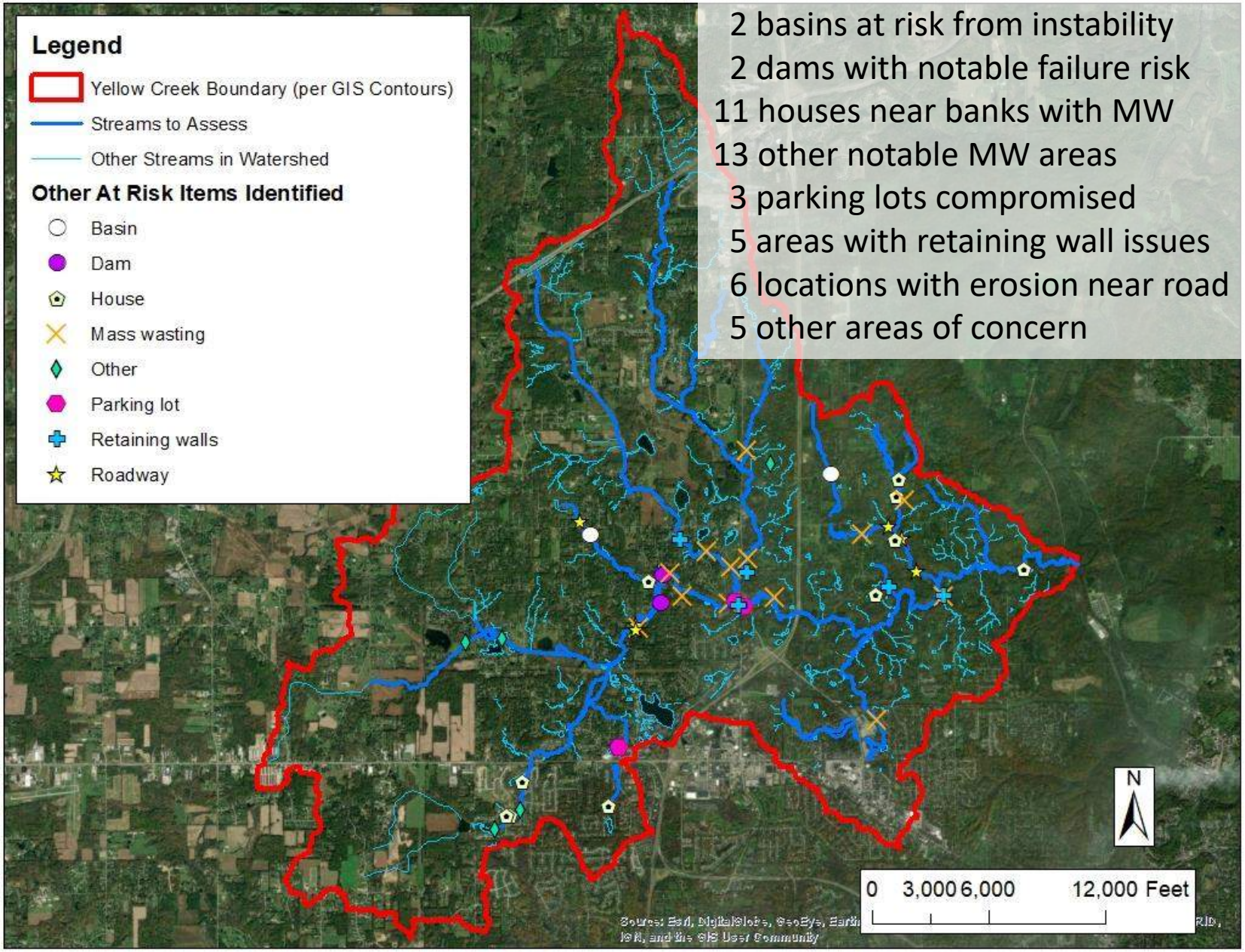


Figure A16. Other at-risk items observed in the watershed
Note: This is not an exhaustive list of risk in the vicinity of streams in the watershed.

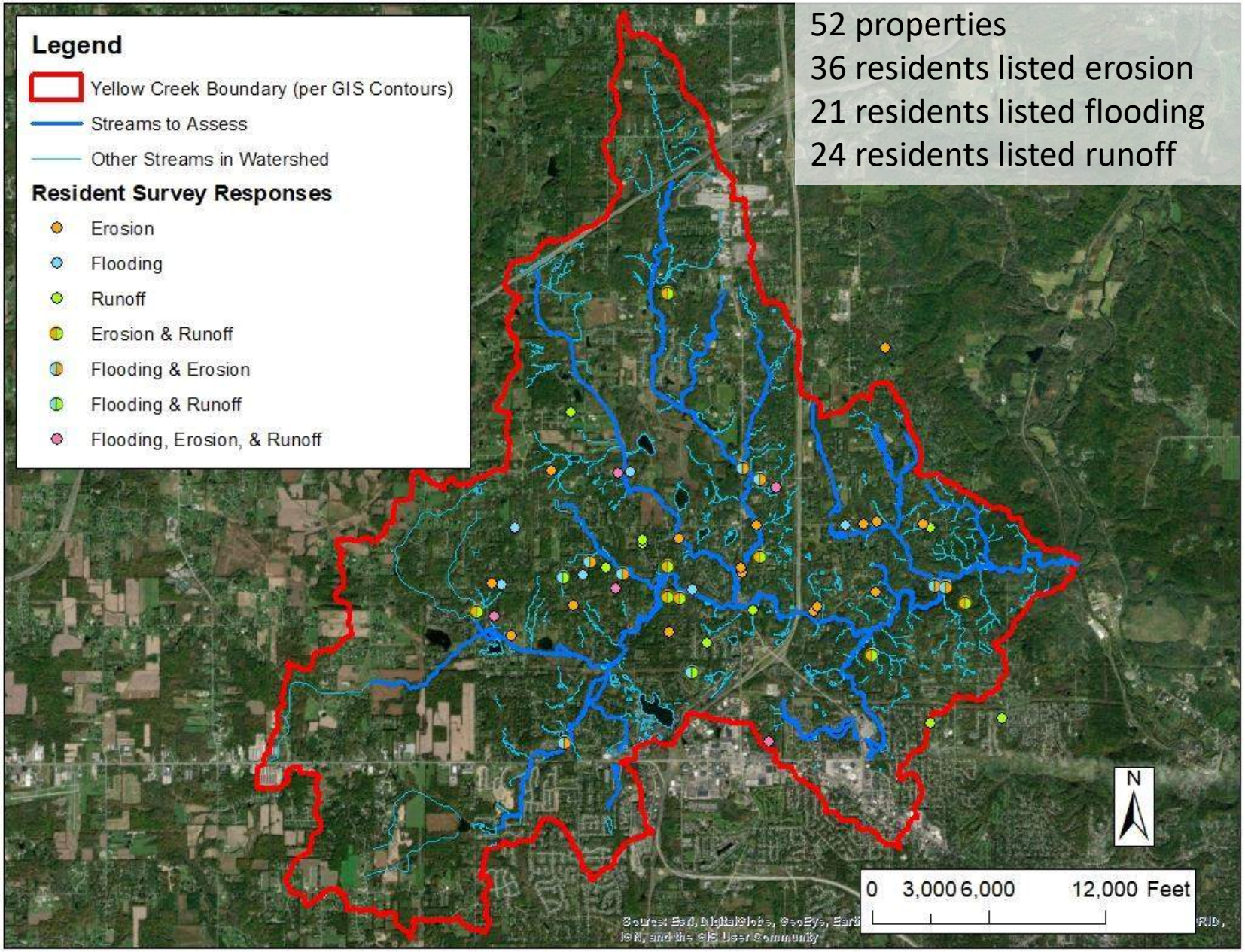


Figure A17. Resident responses to FOYC survey

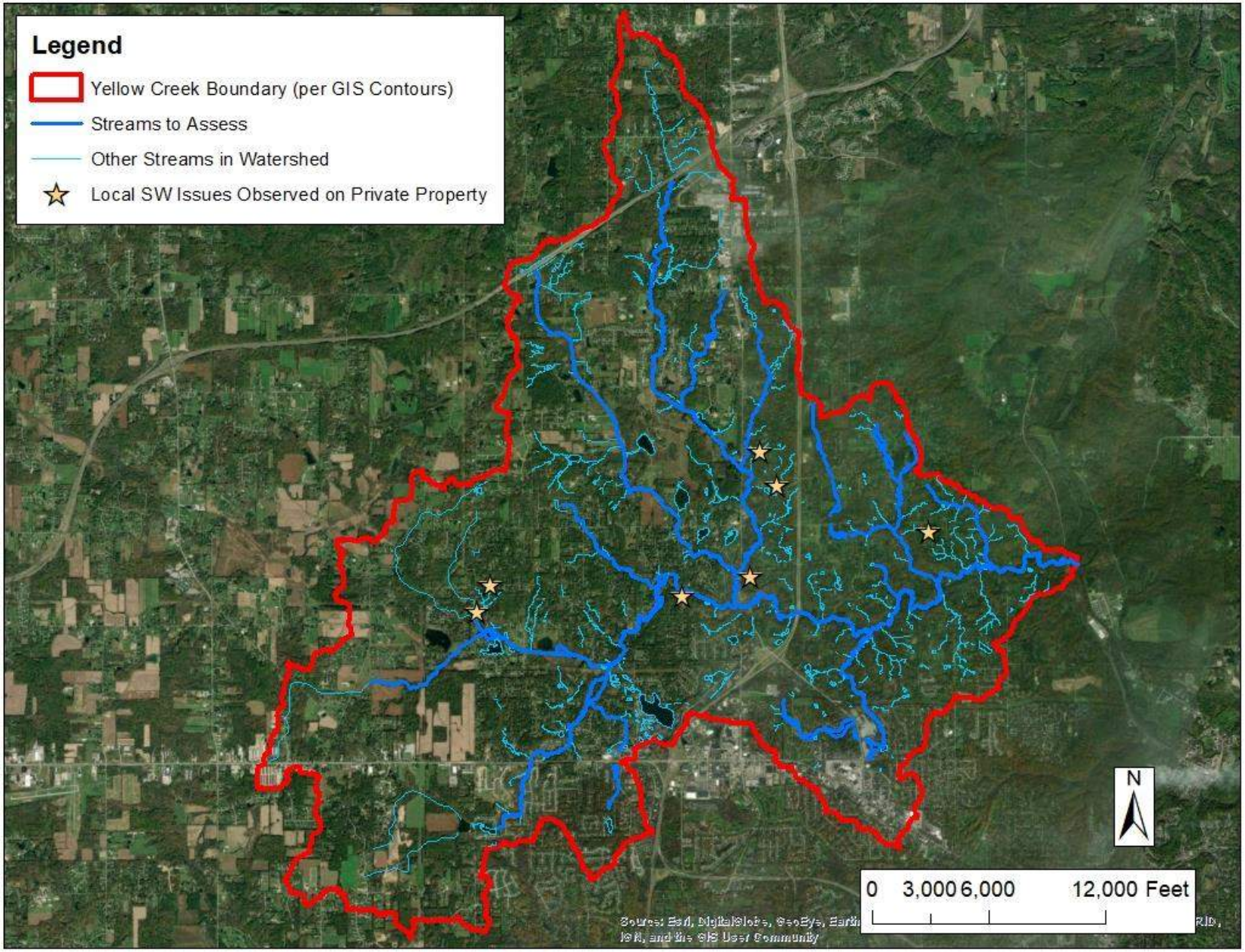


Figure A18. Local stormwater issues observed on private property in the watershed
Note: This is not an exhaustive list of all stormwater issues in the watershed.

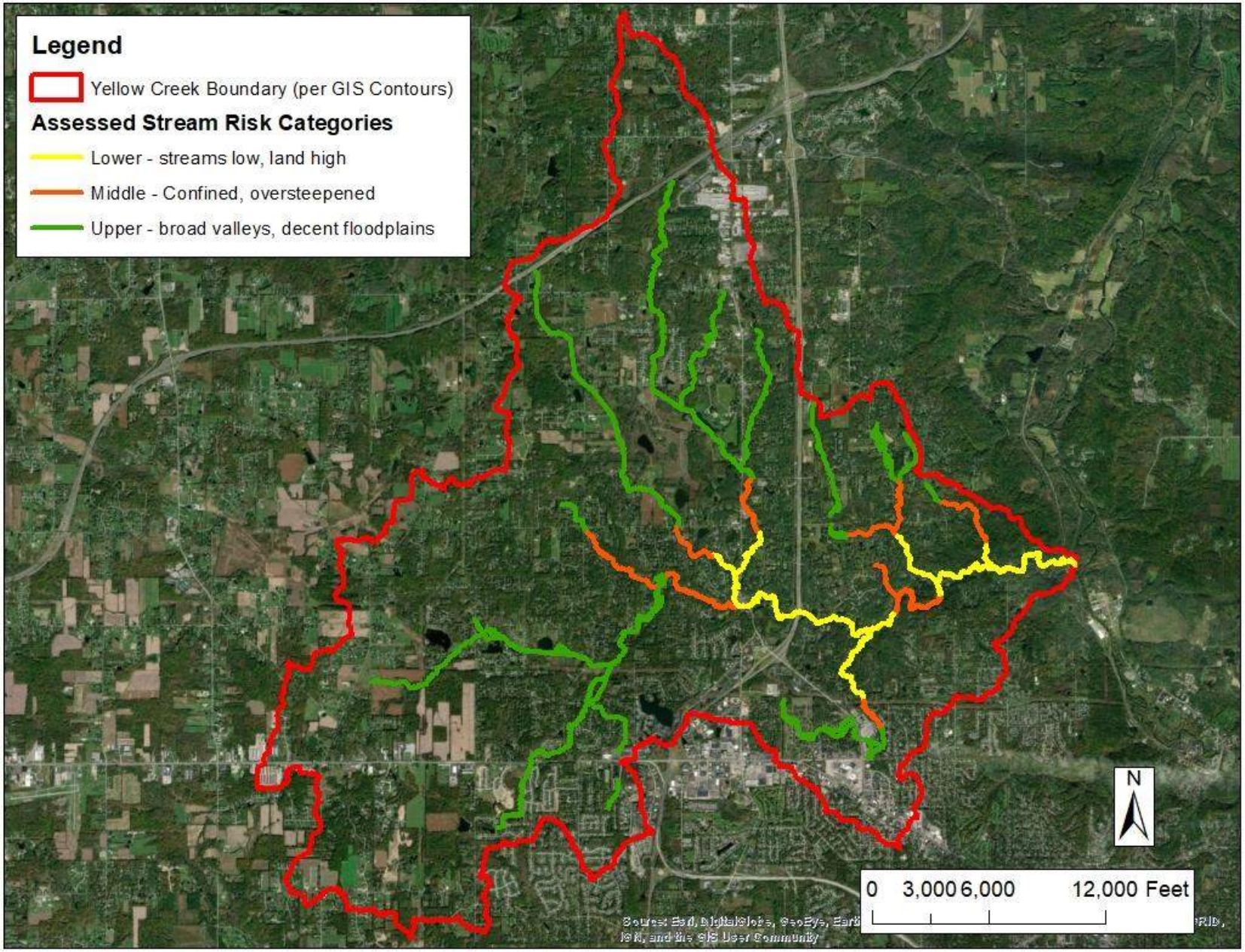


Figure A19. Relative risk categories across assessed streams in the watershed (aerial background)

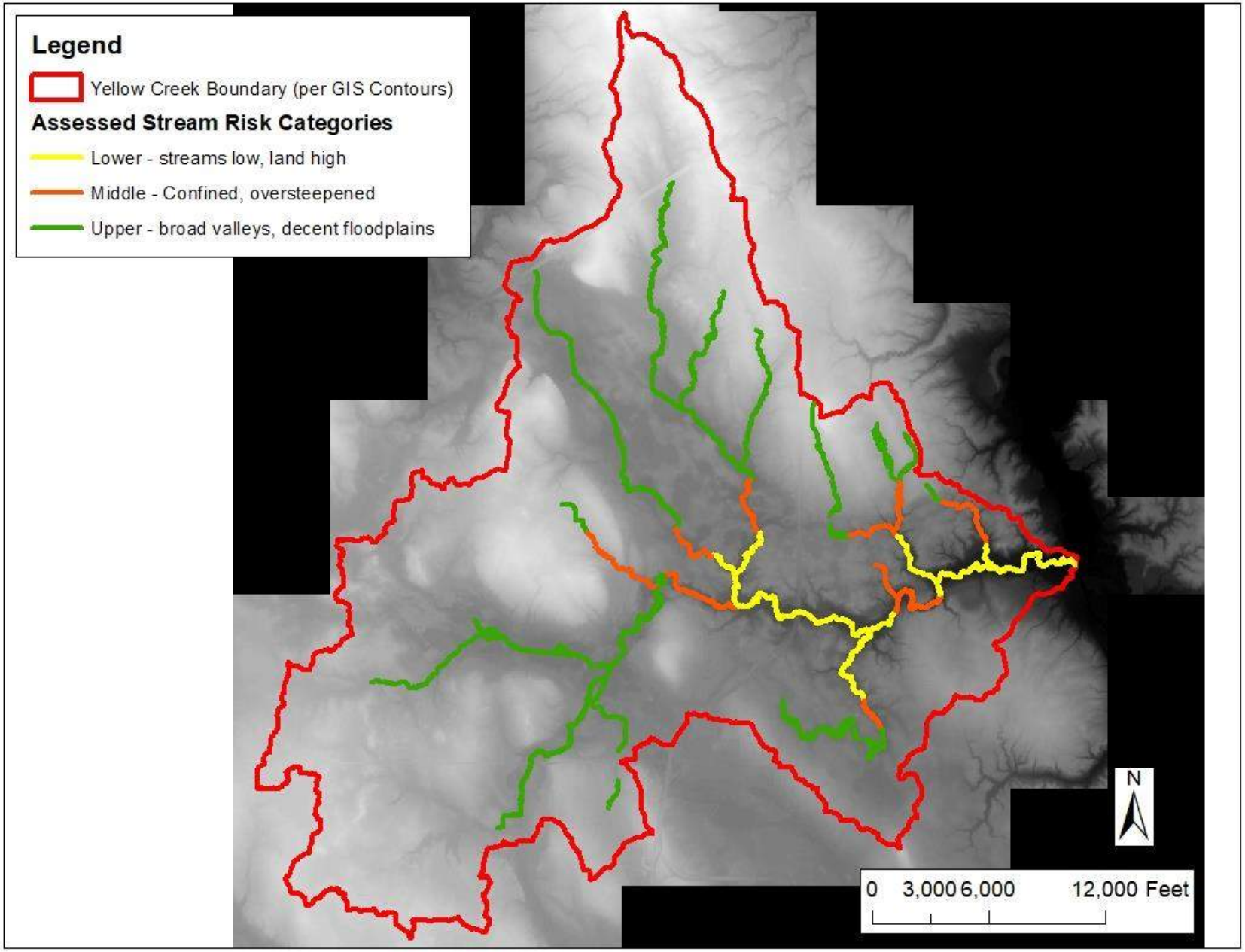


Figure A20. Relative risk categories across assessed streams in the watershed (hillshade background)

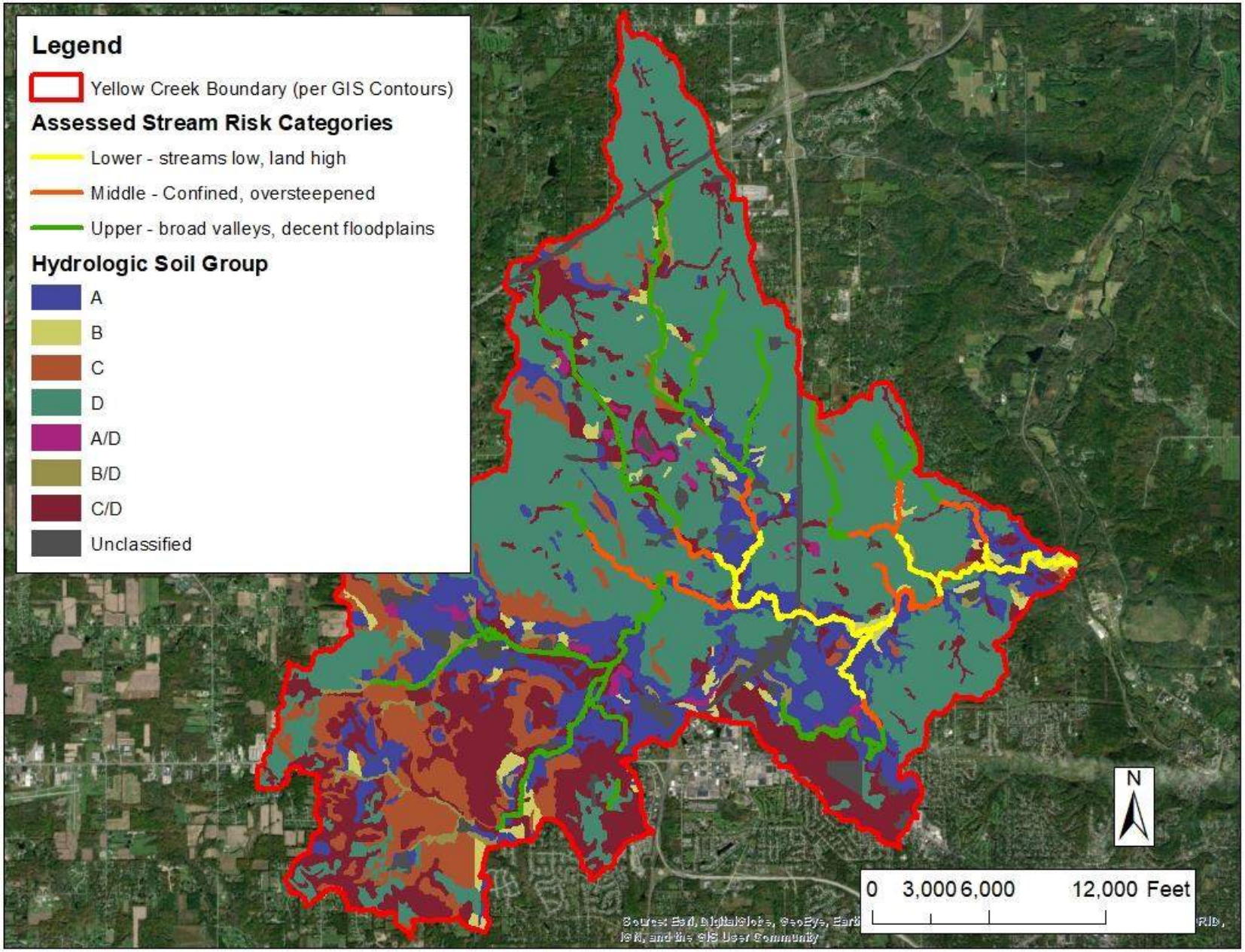


Figure A21. Relative risk categories across assessed streams in the watershed (soils background)

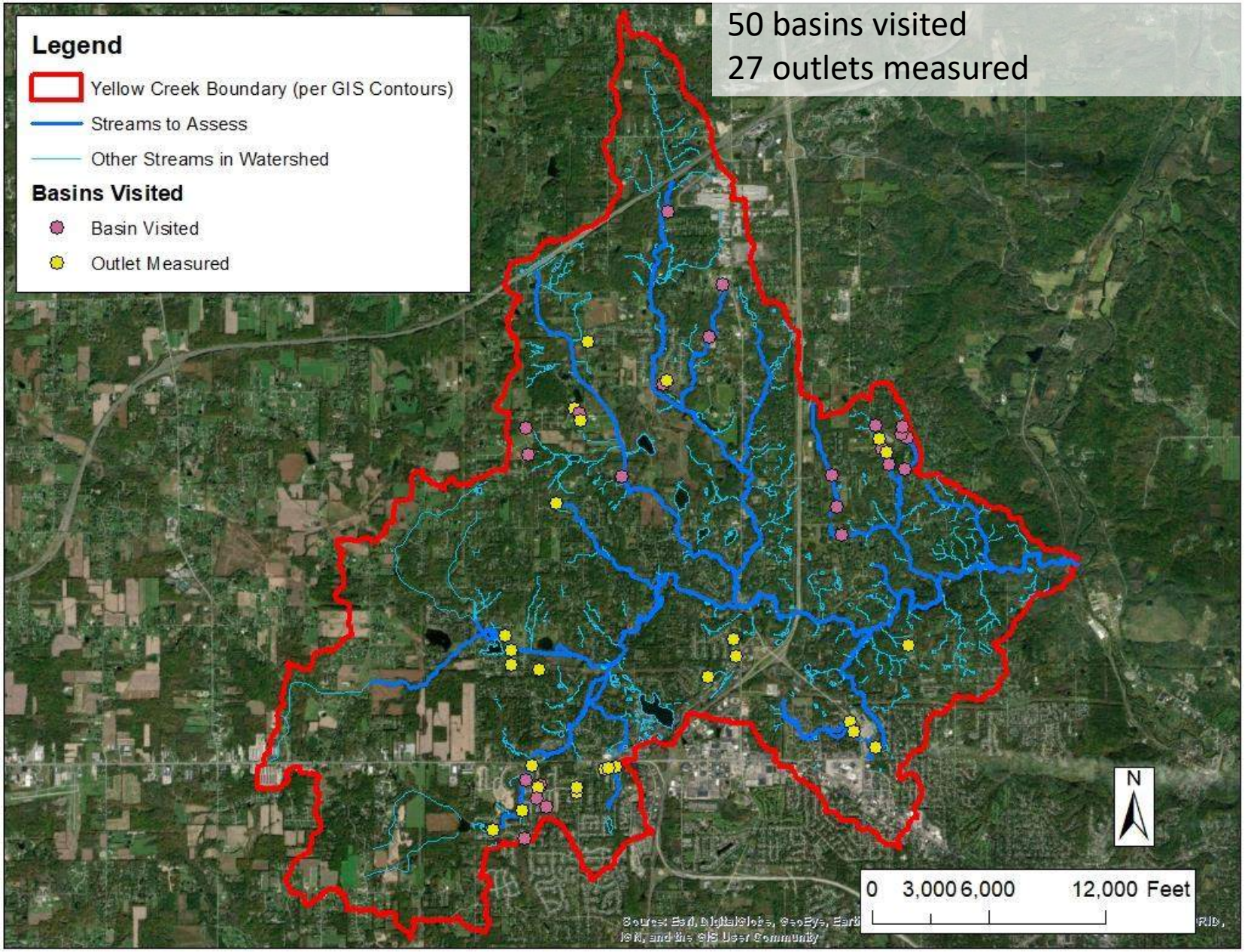


Figure A22. Surface basins observed in the watershed

APPENDIX B

Friends Of Yellow Creek
Resident Survey Summary

Appendix B: Friends of Yellow Creek Resident Survey Summary

The following table summarizes the Friends of Yellow Creek survey sent to residents in Fall 2018. The information is summarized from the surveys and does not reflect observations and/or additional information gleaned by the project team during this project. Specific addresses have been omitted for privacy.

Street	Flooding Reported?	Erosion Reported?	Excessive Runoff Reported?	Loss of Trees Reported?	Notes
Derrwood	*Creek; Side yard*	--	--	--	*Flooding every heavy rain. Planted >100 trees near creek.*
Derrwood	*Creek; Basement; Yard*	*Streambanks; Ditches*	*Heavy rains*	--	*Flooding 3 times in past 10 years. There is more runoff from building upstream.*
Everett	*Yard (stays wet, can't mow)*	*Ditch banks; Yard*	*Almost constant*	--	*"Flooding" is really more like the natural flow of water after hard rains.*
Ghent Hills	--	*Hillside*	*New ditch needed*	*Avg. 1.5/yr*	*Caused by rain and snowmelt. Runoff from neighbor across street causes pooling near roadside and along drive. In 3 years, >1 ft loss of hillside (70' tall x 80' wide).*
Ghent Ridge	*Creek; Across the street*	*Driveway; Yard*	*From neighbor's*	--	*Significant rain causes creek near road to overflow and flood driveway. Runoff crosses Ghent Ridge from across the street. Sediment collects at end of driveway.*
Granger	*Yard*	--	*Heavy rains*	*Some*	*More flooding in recent years.*
Granger	*Driveway*	*Ravines; hillsides*	*Severe*	*2 in 30 yrs*	*Washout of driveway and damaged culvert from flows from another property. Upstream septic systems appear to not be working properly. Repaired the driveway 5-6 times.*
Harmony	--	--	*From neighbor's*	--	*Difficult to mow with the runoff from the neighbors*
Meadow Park at Forest Pool	*Creek; Storm sewer*	*Streambanks*	--	--	*This is caused by heavy storms. Over 30 years, Bath Creek has doubled in width (now 12-16 ft) and is 2-4 feet deeper.*
Montrose	*Basement; Yard; Driveway*	*Streambanks; Yard*	*Very severe*	--	*Additionally, debris is brought onto property every rain storm.*
N Cleveland-Massillon	*Creek; Yard*	*Streambanks; Yard; Ravine; Hillside*	--	*Many trees from erosion*	*Erosion is now close to septic system. Rock and soil from upstream bridge has changed flow and tripled erosion.*
N Cleveland-Massillon	*Creek; Yard*	*Ditch banks*	*Extreme*	*Entire area along ditch*	*Small run has changed from 20" in depth to >10 ft. Remedied with 2,200-lb bin blocks and weirs. Seems to be water from Ghent Hills Rd.*

Street	Flooding Reported?	Erosion Reported?	Excessive Runoff Reported?	Loss of Trees Reported?	Notes
N Hametown	*Yard; New channels formed*	*Streambanks; Yard; Ravine*	*2-4x/year*	*Where it stays wet*	*New channels are being created due to erosion. Lived here for 67 years.*
N Hametown	*Basement; Yard; Driveway*	*Little*	*Little*	--	--
N Medina Line	*Street; Yard; Driveway*	*Yes, end of driveway*	*Large pools at street*	--	--
North Shore	*Neighbors; Yard; Garage*	*Yard; Hillsides*	*Passes through property*	--	*Drains at street do not appear to keep up with rain, as water just flows down the street. Runoff can come from neighbor's through the back yard, and then to the other neighbors.*
Partridge	*Creek; Basement; Yard*	*Streambanks; Hillsides*	*Yes*	--	*Flows have washed out the driveway. Culvert under Partridge Lane is too small. Have dredged creek twice since 2013. Changed in the 38 years in the house.*
Ranchwood	*Basement; Yard*	*Yard (moderate)*	*Severe*	--	*Flooding is caused by runoff from the neighborhood to the north (Pin Oak).*
Ranchwood	--	*Moderate*	*Moderate (3x/yr)*	--	*Further details were provided to SWMD.*
Robinson Spur	*Stream & sewers; Yard*	*Streambanks; Ditch banks; Yard*	*Damaging*	*Loss of walk bridge*	*Since 2011, spillway has deepened 4 ft, widened 5 ft, and washed out 3'x10' culvert and earthen bridge*
Rock Ridge	--	--	*One to ten*	--	--
Rolling Meadows	*Basement; Yard*	--	*Floods front and side yards*	--	*2 to 3 times over the last 12 years, there has been 4-6 inches of water in the basement when the front yard floods*
Rolling Meadows	*Yard*	--	*Yes*	--	*Rarely have minor sediment and debris. Flooding hinders lawn mowing.*
Sanctuary	*Street runoff; Basement*	--	*Flooding in road*	--	*~6 times since 2000 (3 of them in the last 4 years), flooding in the road prevent the footer drains from flowing and will back up into finished basement-*
Sandin	*Basement; Yard*	--	*Moderate*	--	*Culverts in neighborhood are obstructed/clogged/weedy/gross. Basement floods in 100-year storm*

Street	Flooding Reported?	Erosion Reported?	Excessive Runoff Reported?	Loss of Trees Reported?	Notes
Shaw	*Creek; Valley*	*Streambanks; Ditch banks; Yard; Ravines; Hillsides*	*Yes*	*Yes*	--
Shaw	*Basement (once)*	--	*Severe*	*Several every year*	--
Shaw	*Creek*	*Yard*	--	*Microburst*	--
Short Hills	*Yard*	*Yard; Hillsides*	*Yes*	*~1 every 2-3 years*	--
Stonegate	--	*Yes*	--	--	--
Timberline	*Outbuildings; Yard*	*Ditch banks; Yard;*	*Severe*	*A couple per year*	*Debris on property includes car battery, tires, construction debris, bottles, car parts, etc. In the last 2 years, hillside has dropped at least 24 inches and have lost 3-4 feet due to erosion in drainage area that cuts through our entire front yard from stormwater from the development*
Top 'O Hill	--	*Creek*		*~1-2/year*	*Creek bed overflows its banks, and erosion occurs around 2/3rd of property.*
Treecrest	*Yard*	*Severe*	*Severe*	*Periodically*	*Debris whenever it rains. Considerable change over 15 years. Issues seen whenever it rains.*
Trellis Green	*Yard*	*Streambanks*	--	*~5 in 23 years*	*Over 23 years, the land between the creek and pond has diminished quite a bit.*
W. Bath	*Yard*	*Ravines*	*Yes*	--	*Have lost 5 feet of soil going into ravine*
W. Bath	--	*Moderate (only 2014)*	--	*1 tree 14 years ago*	*Ove 25 years, the course has altered at the bottom of the ravine*
W. Bath	--	*Streambanks*	*Yes*	*Regularly*	*Every storm over 2 inches comes from Bath Rd., then this property, to ravine then creek. Bath Rd. leveled 10-12 years ago*
W. Bath	*House; Basement; Yard*	--	--	--	*Infrequent flooding (2004, 2011, 2014). Flooding is due to inadequate size of culvert under Bonnebrook Rd which caused backup.*

Street	Flooding Reported?	Erosion Reported?	Excessive Runoff Reported?	Loss of Trees Reported?	Notes
W. Bath	*Yard*	*Streambanks*	*In stream*	*Along streambanks*	*Frequent debris and pollution in stream. Over 8 years, the stream width has at least doubled. Both streams roar during heavy storms. During the big flood a couple years ago, front yard filled as stream overflowed, crossed W. Bath, and took driveway with it. Nearly moved barn stones on the side of stream by underpass.*
W. Bath	*Basement (1 every 5 yrs)*	--	--	--	--
Westridge	--	*Streambanks; Ditch banks; Hillsides*	*During heavy rain*	--	*Eroding the front of property and driveway. Have tried to shore up where stormwater flows, but constant erosion has caused every remedy to fail. Cement driveway is now loose/moving.*
Yellow Creek	*Creek; Outbuildings*	*Streambanks; Ditch banks; Yard; Ravines; Hillsides*	*Very severe*	*Huge amount of damage*	*3 buildings have sustained damage from flooding. Debris/sediment is very severe. Foam pollution noted. Damage to all outbuildings, bridges, walkways. Lived here over 20 years and have noticed a huge change.*
Yellow Creek	*Creek; Yard*	*Streambanks; Yard*	*Severe and frequent*	*Frequent and severe*	*Lost 10 feet of property to Yellow Creek and a tributary. Pollution noted, including bottles, bags, wood, building materials, and a camper. Lived here 13 years, with issues getting progressively worse from roadways and developments.*
Yellow Creek	--	*Ditch banks; Yard; Hillsides*	*Minor to very bad*	--	*Lived here since 2011. A large log jam near Yellow Creek Rd and Cleve-Mass seems to be getting bigger and forcing more erosion. 2014 caused the worst issues, with 2017 and 2018 having more minor issues.*
Yellow Creek	*Yes*	*Yes*	*Yes*	*Yes*	*Large storms cause the issues. High water brings pollution. When I-77 expanded lanes, issues got worse.*
Yellow Creek	*Yard*	--	--	--	*There is no drainage along the front of property on Yellow Creek Rd.*

APPENDIX C

Hydrogeomorphic Data

The following data are based on level-tape surveys and pebble counts using industry standard methods for the purposes of estimating the critical discharge (Qcritical) for streambed particle mobility (Hawley and Vietz, 2016). Vertical and horizontal datums are arbitrary.

Site: **2226 W. Bath Rd.**

Imp: 8.51% (approximate, based on StreamStats/NLCD 2011 impervious dataset)

DA: 30.6 mi^2

Notes: Slope is flatter (~1%), macroinvertebrates found on 90s (d60) but not 64s (d45). As such, d50 is appropriate as a representative bed material for Qc.

Date	BF Area (ft^2)	BF Depth (ft)	BF Top Width (ft)	Slope (ft/ft)	Pool/Riffle Ratio	d50 (mm)
12/5/2018	445.99	6.22	100.95	0.0086	1.69	71.43

Figure C1: Looking upstream from cross section location.

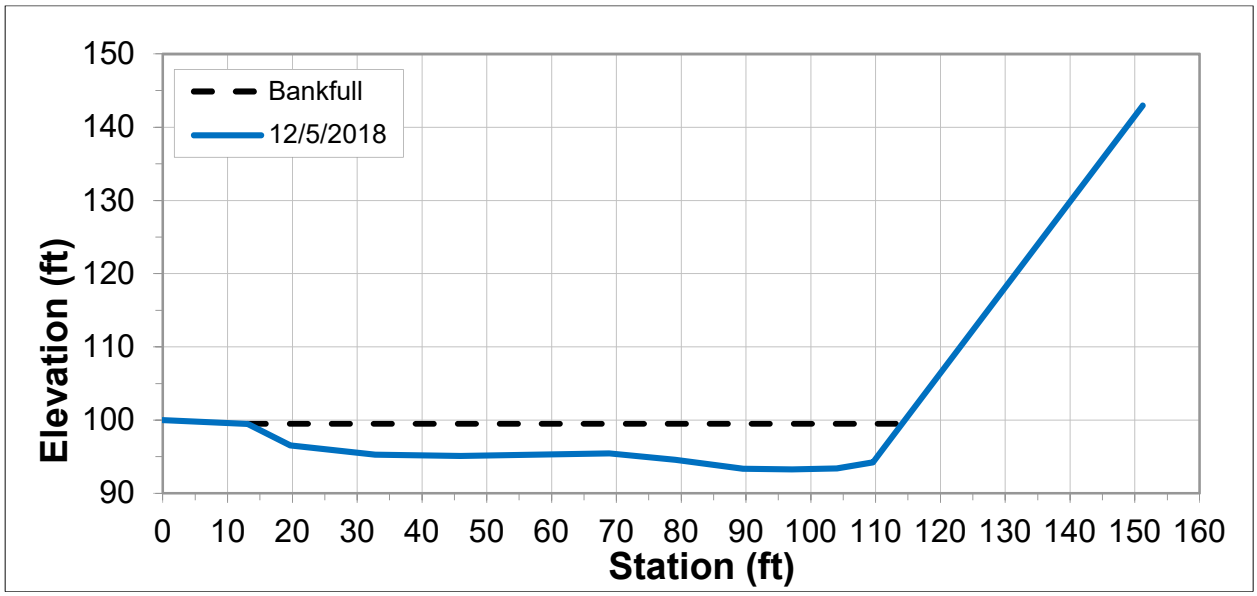


Figure C2: Cross section of site

Site: **2226 W. Bath Rd.** (continued)

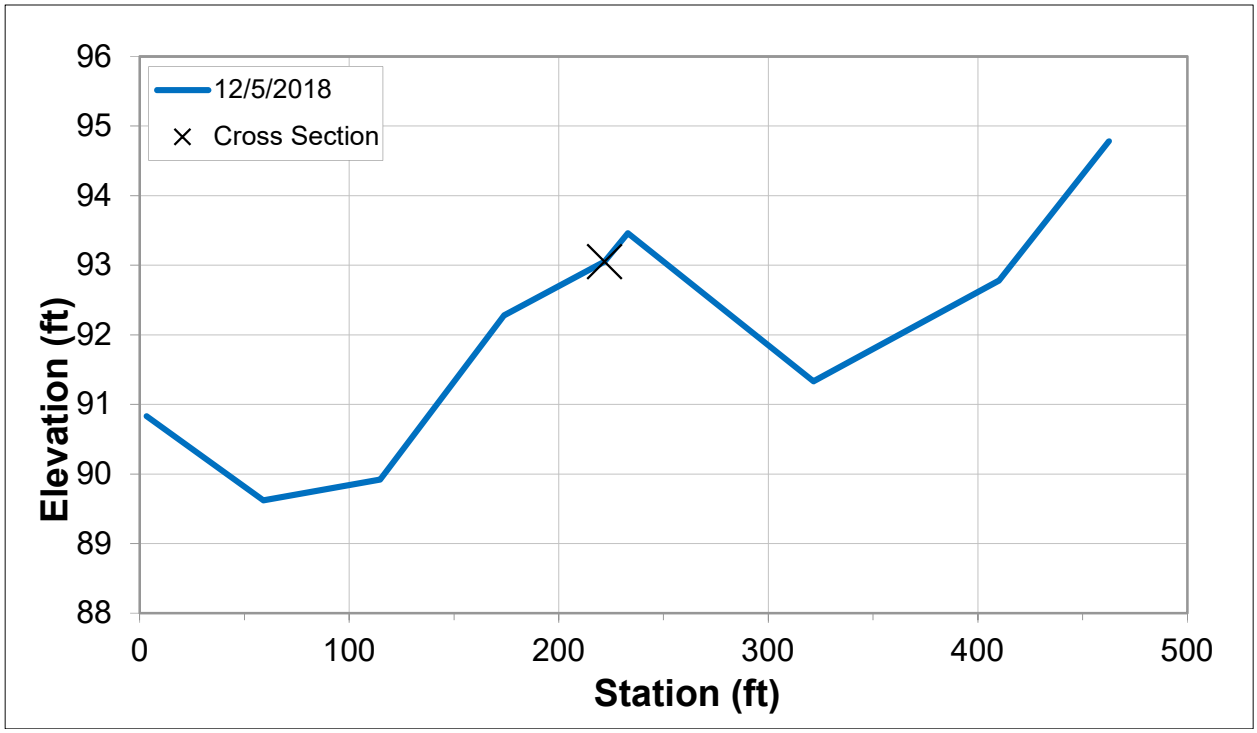


Figure C3: Profile of site

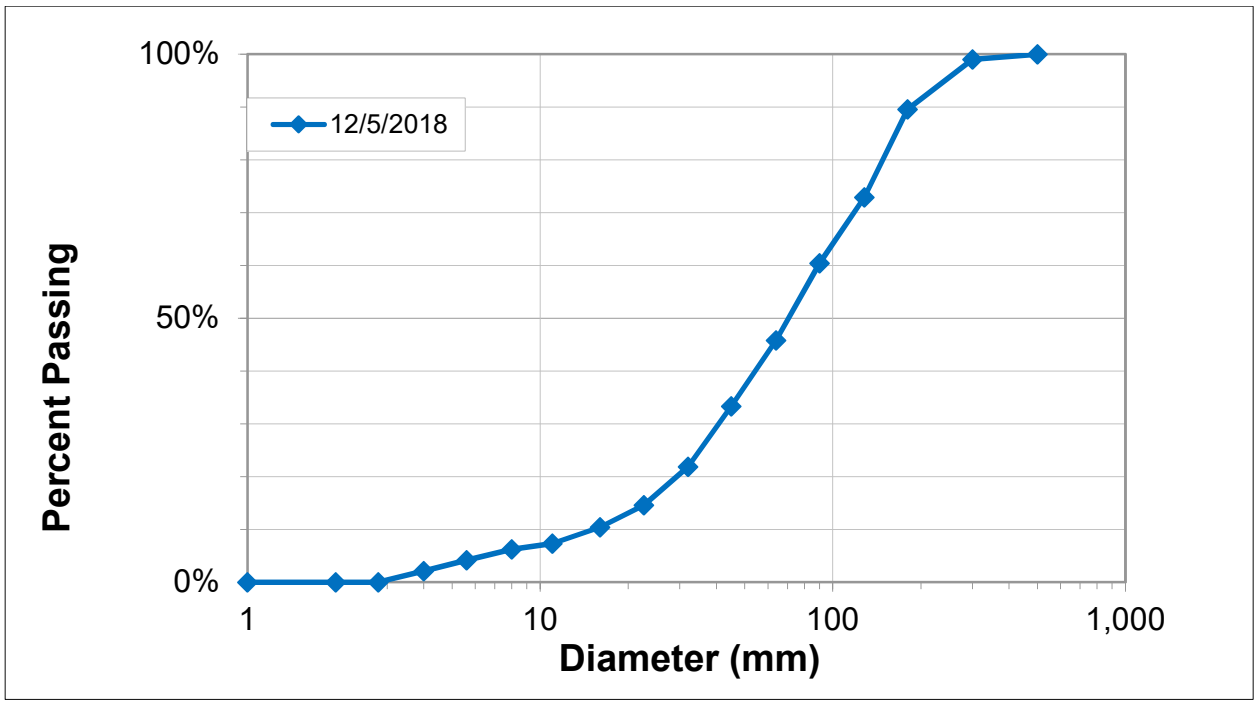


Figure C4: Bed material gradation at site

Site: **3495 Yellow Creek Rd.**

Imp: 6.64% (approximate, based on StreamStats/NLCD 2011 impervious dataset)

DA: 23.00 mi^2

Notes: Slope is flatter (<1%) with large bars of rounded material. The fact that the pebble count riffle was submerged and had macroinvertebrates on 32s (d50) suggests hiding (less frequent mobility than the Qc estimate associated with this riffle slope (9%) would suggest). This warranted using the downstream riffle slope, which was associated with a Qc estimate (39% of Q2) that was more consistent with the regional Qc estimate (~40% of Q2).

Date	BF Area (ft^2)	BF Depth (ft)	BF Top Width (ft)	Slope (ft/ft)	Pool/Riffle Ratio	d50 (mm)
12/6/2018	54.85	2.26	37.65	0.0075	37.47	30.55

Figure C5: Looking downstream near cross section location

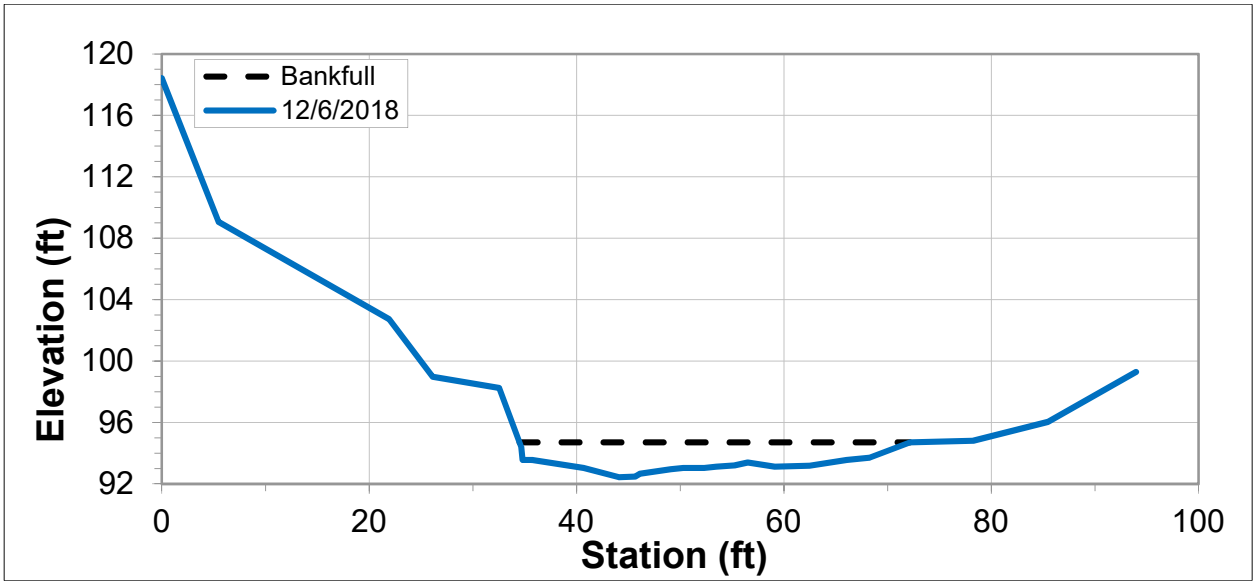


Figure C6: Cross section of site

Site: **3495 Yellow Creek Rd.** (continued)

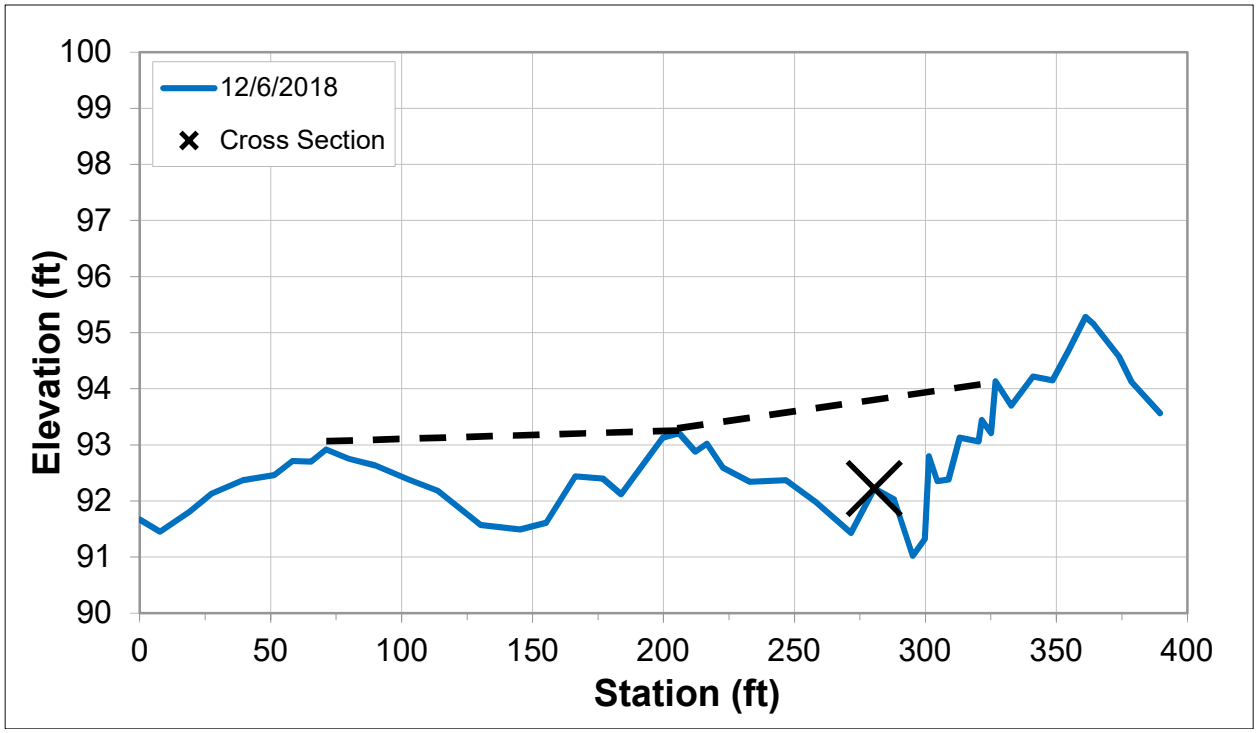


Figure C7: Profile of site

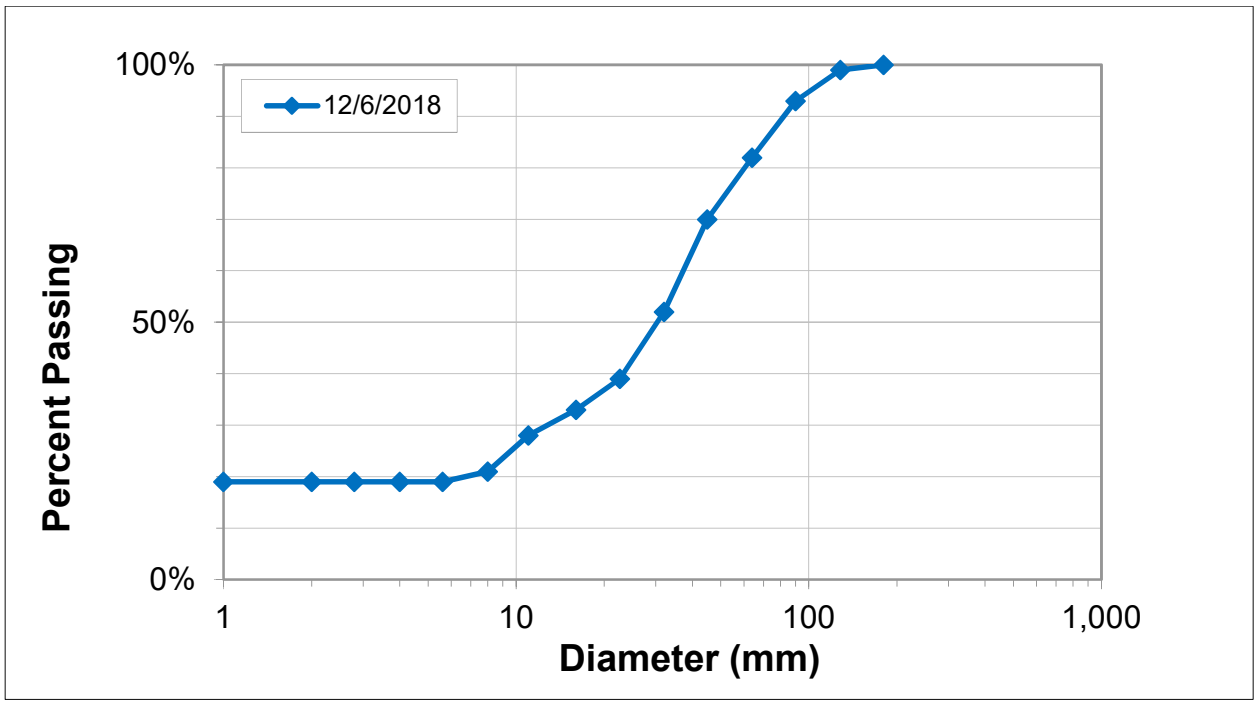


Figure C8: Bed material gradation at site

Site: **3757 Bath Rd.**

Imp: 8.03% (approximate, based on StreamStats/NLCD 2011 impervious dataset)

DA: 5.72 mi^2

Notes: Slope is flatter (<1%). Macroinvertebrates on d20 suggests hiding behind d50s. Qc associated with d50 seems appropriate.

Date	BF Area (ft^2)	BF Depth (ft)	BF Top Width (ft)	Slope (ft/ft)	Pool/Riffle Ratio	d50 (mm)
12/6/2018	642.64	10.51	88.25	0.0046	4.36	37.69

Figure C9: Looking downstream from cross section location

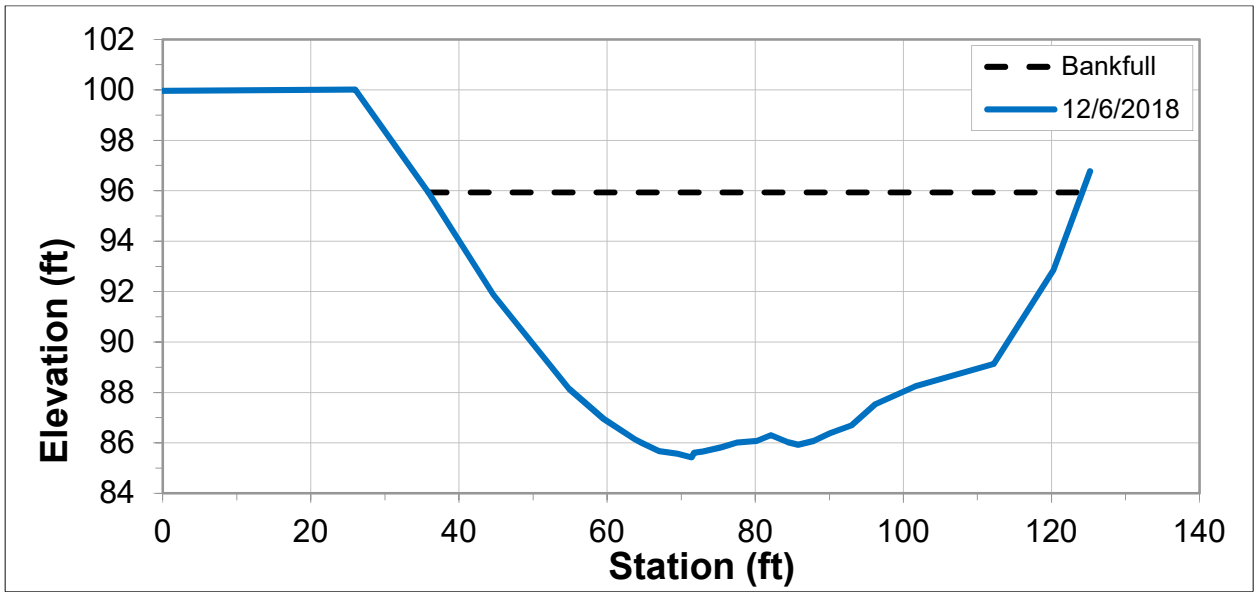


Figure C10: Cross section of site

Site: **3757 Bath Rd.** (continued)

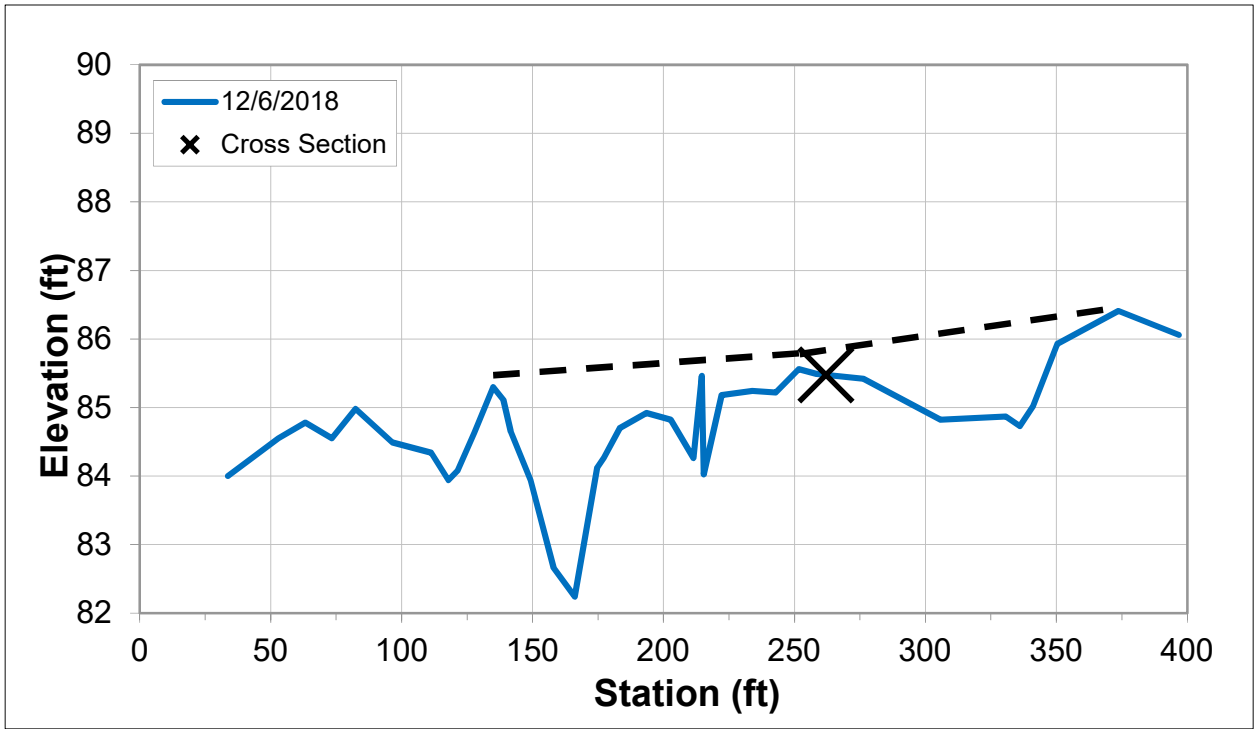


Figure C11: Profile of site

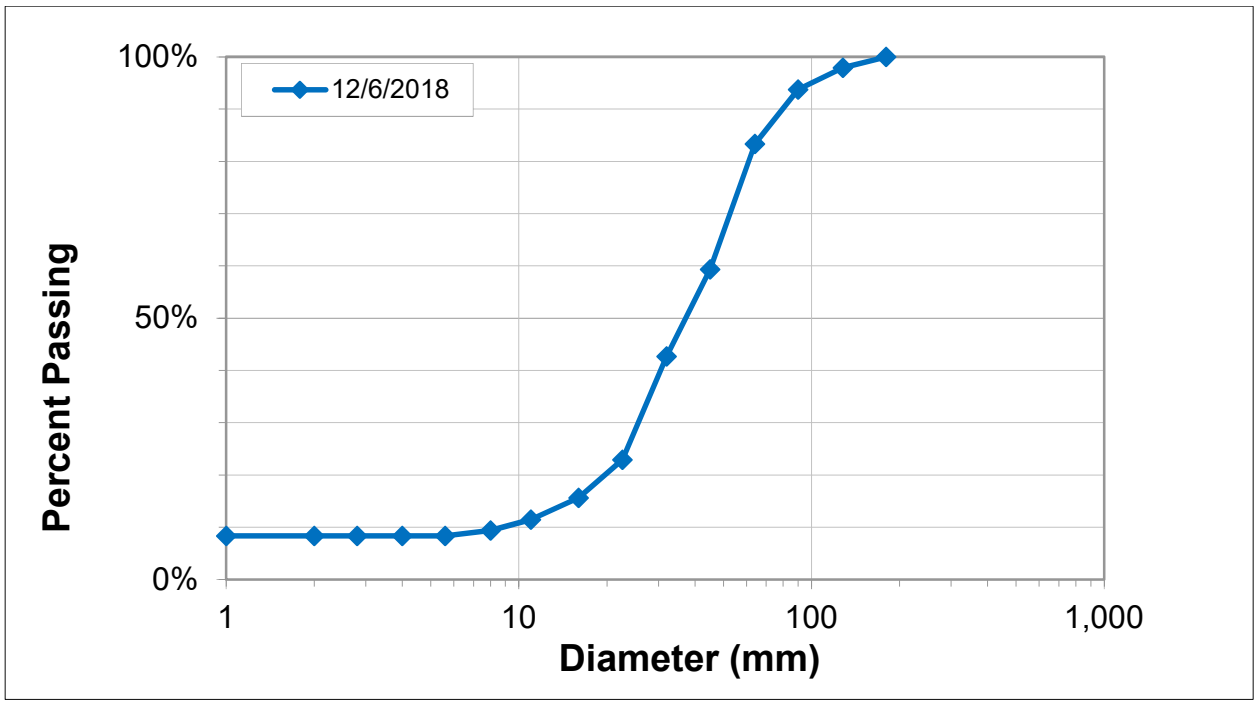


Figure C12: Bed material gradation at site

Site: **1405 Fox Chase Dr.**

Imp: 2.54% (approximate, based on StreamStats/NLCD 2011 impervious dataset)

DA: 3.30 mi^2

Notes: Slope is flatter (<1%). Macroinvertebrates only on 64s, which corresponds to d95. Site could be entering a depositional valley, making its pebble count skewed to the finer end (i.e. perhaps it's downstream of a steeper knickpoint zone). Qc associated with d84 (38% of Q2) is more appropriate than Qc associated with d50 (9% of Q2).

Date	BF Area (ft^2)	BF Depth (ft)	BF Top Width (ft)	Slope (ft/ft)	Pool/Riffle Ratio	d50 (mm)
12/6/2018	7.97	0.83	13.69	0.0077	0.46	23.09

Figure C13: Looking upstream. Cross section tape visible.

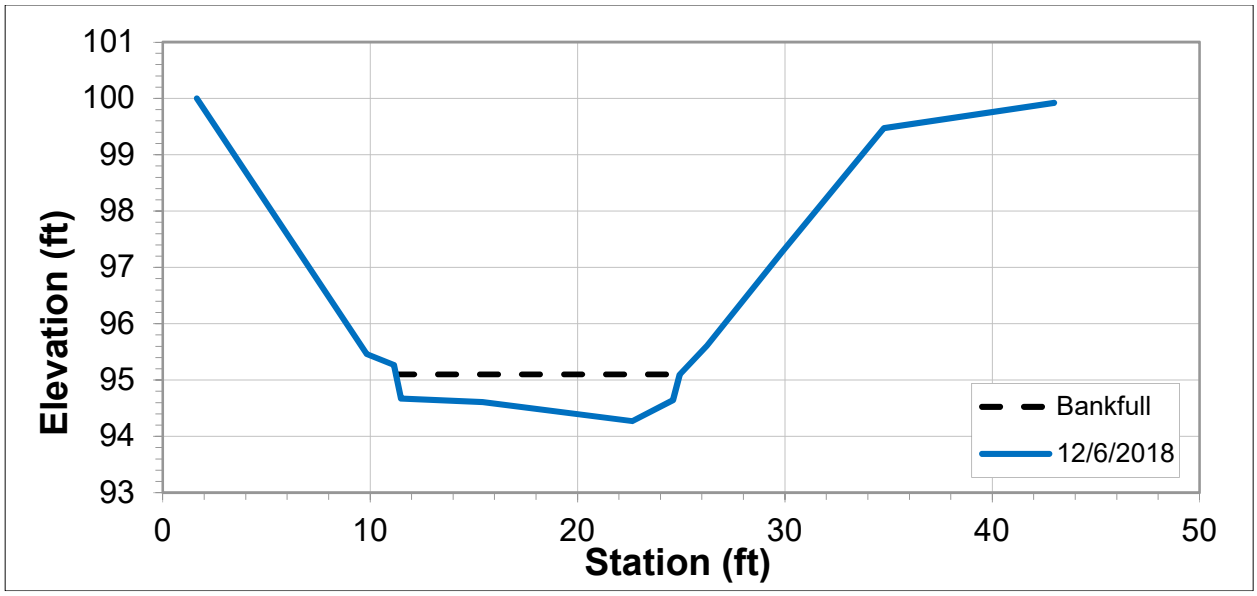


Figure C14: Cross section of site

Site: **1405 Fox Chase Dr.** (continued)

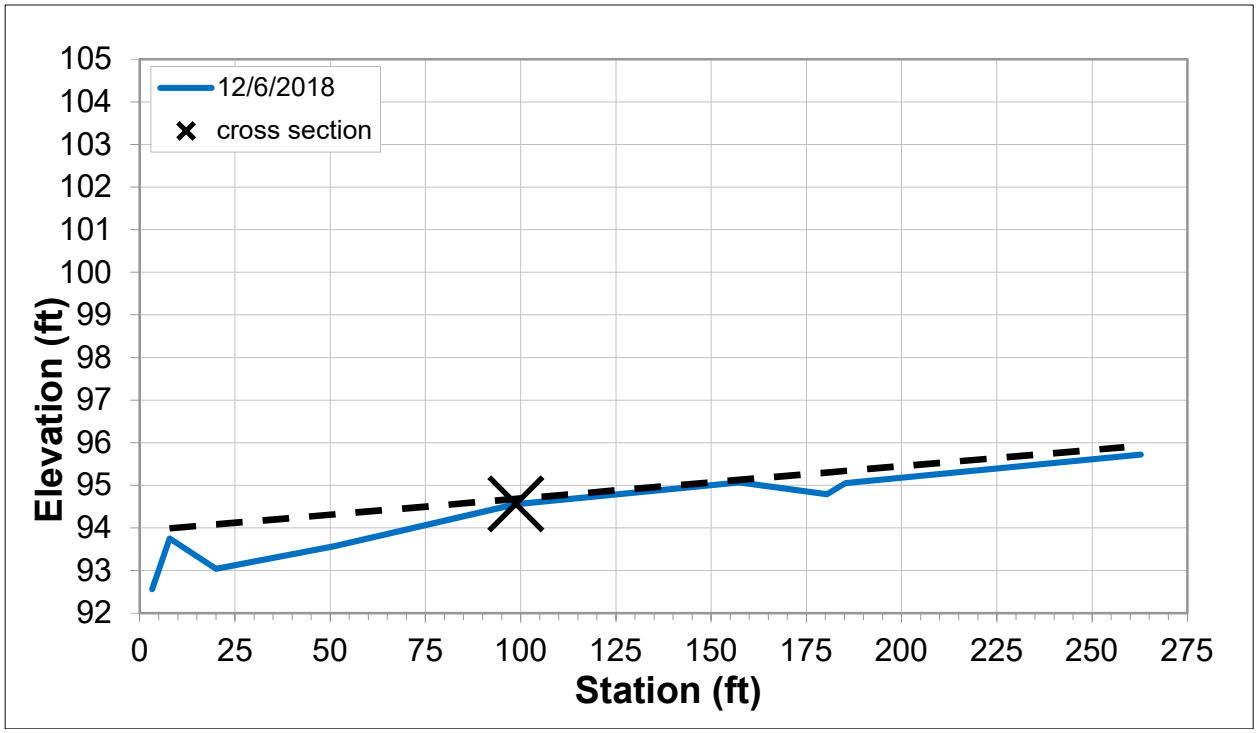


Figure C15: Profile of site

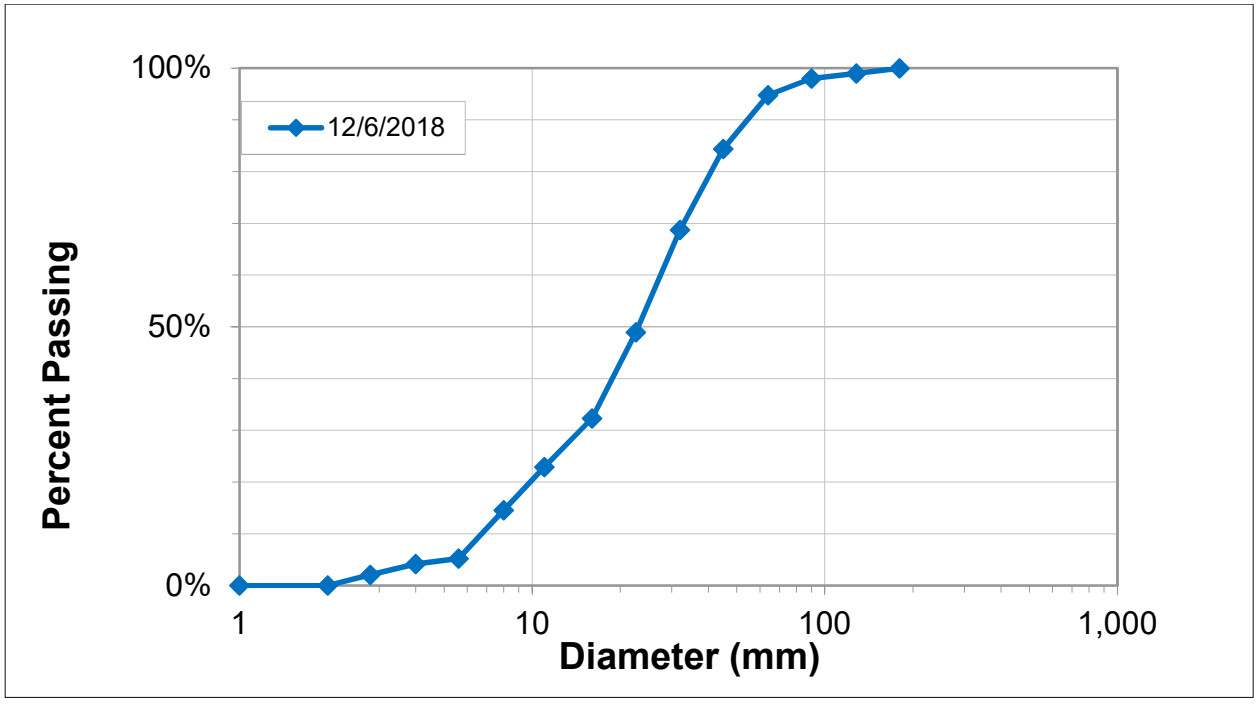


Figure C16: Bed material gradation at site

Site: **588 Medina Line Rd.**

Imp: 5.18% (approximate, based on StreamStats/NLCD 2011 impervious dataset)

DA: 2.21 mi^2

Notes: Slope is flatter (<1%). Mobile gravel bed (no macroinvertebrates observed) with nearby grade control to protect sewer crossing. Site may be overly fine due to the influence of grade control. As such, it may not be a representative site to inform the regional Qc estimate.

Date	BF Area (ft^2)	BF Depth (ft)	BF Top Width (ft)	Slope (ft/ft)	Pool/Riffle Ratio	d_{50} (mm)
12/5/2018	36.35	3.36	15.04	0.0086	0.41	19.71

Figure C17: Looking upstream with tapes laid out for cross section and profile

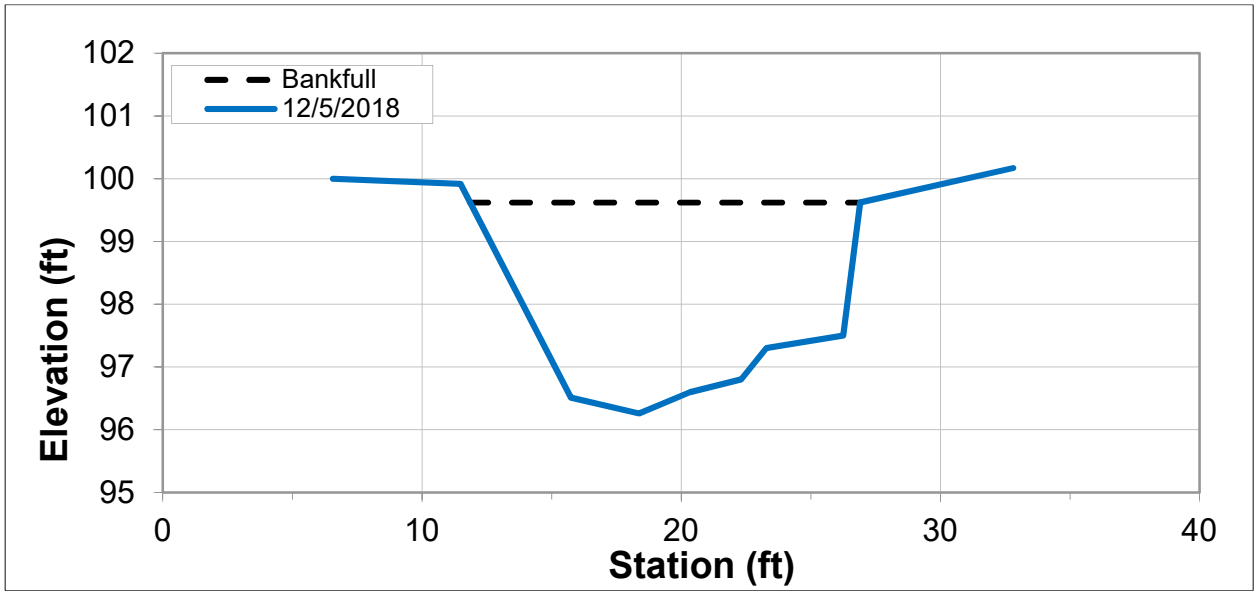


Figure C18: Cross section of site

Site: **588 Medina Line Rd.** (continued)

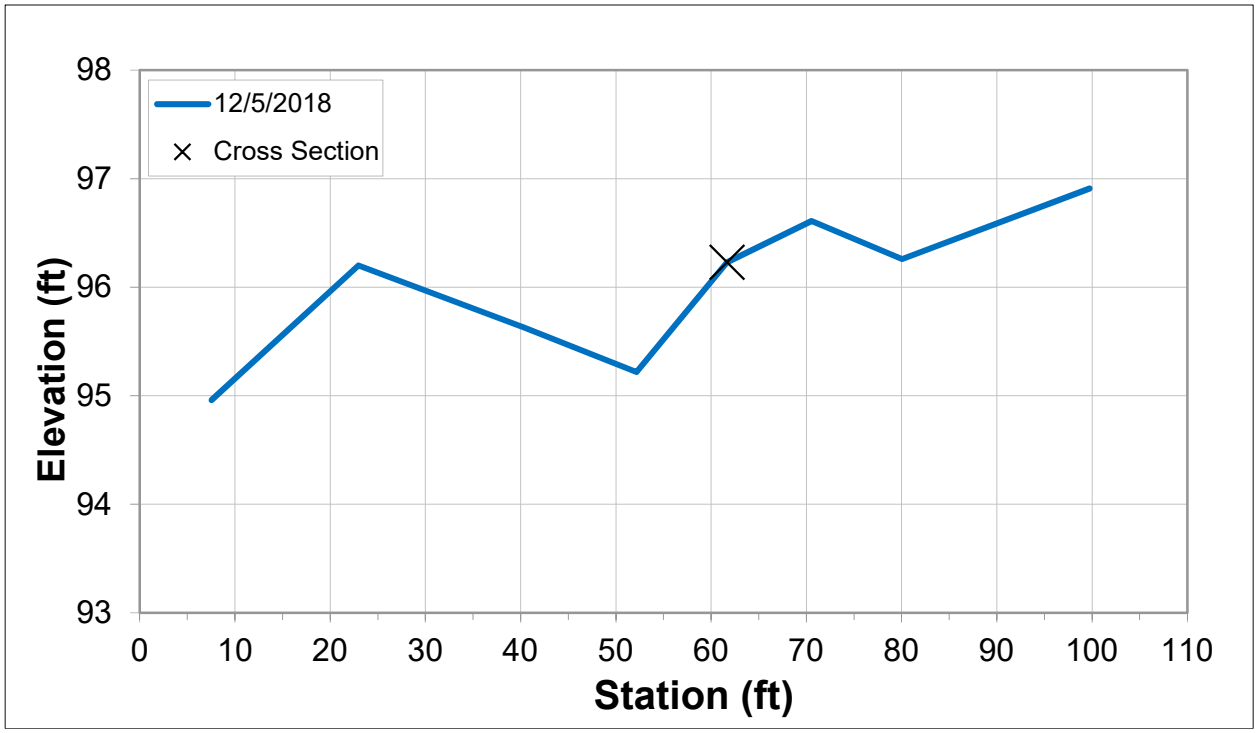


Figure C19: Profile of site

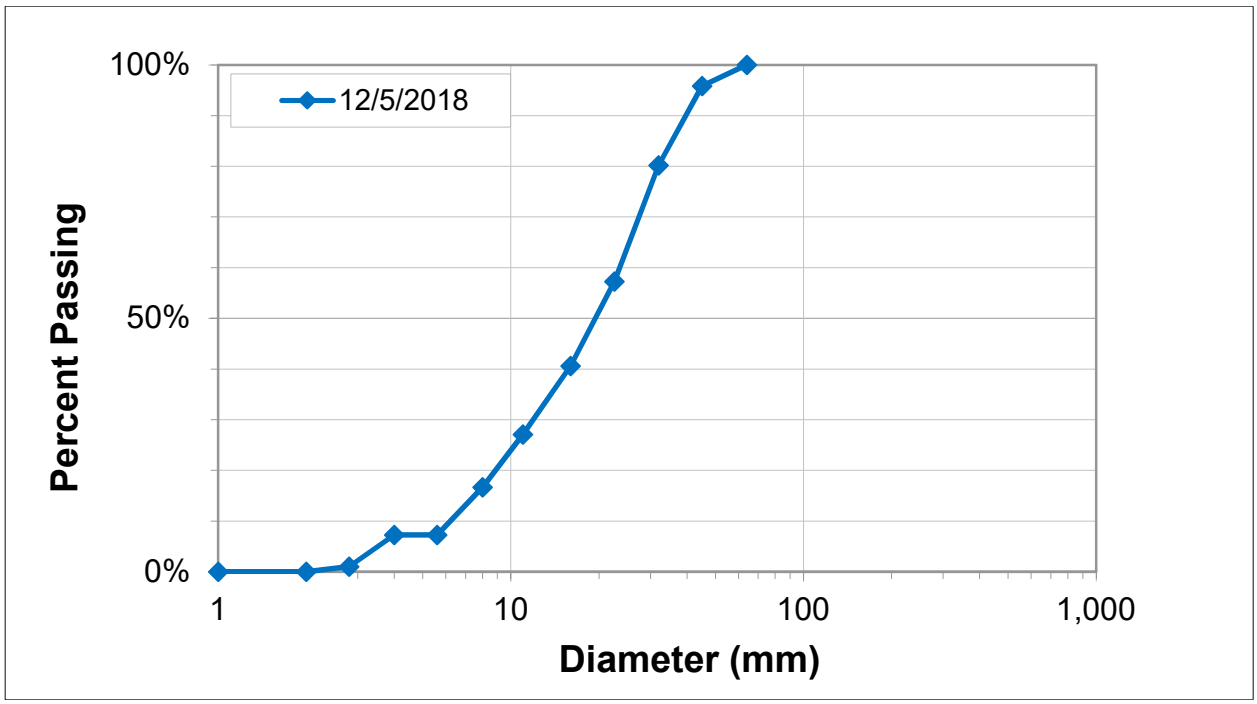


Figure C20: Bed material gradation at site

Site: **4023 Shaw Rd.**

Imp: 4.05% (approximate, based on StreamStats/NLCD 2011 impervious dataset)

DA: 0.53 mi^2

Notes: Slope is moderate (2%), with lots of incision evident in upstream reaches. No macroinvertebrates reported, but this reach could dry out (small watershed). Qc values are probably representative of how infrequent d84 moves and how frequent particles that aren't hiding move, but true Qc is probably more associated with d65 on a transitional reach like this (between a pool-riffle (relatively flat) and step-pool (steeper) profile form).

Date	BF Area (ft^2)	BF Depth (ft)	BF Top Width (ft)	Slope (ft/ft)	Pool/Riffle Ratio	d50 (mm)
12/6/2018	12.70	0.96	18.37	0.0195	0.33	32.00

Figure C21: Looking upstream. Cross section tape visible.

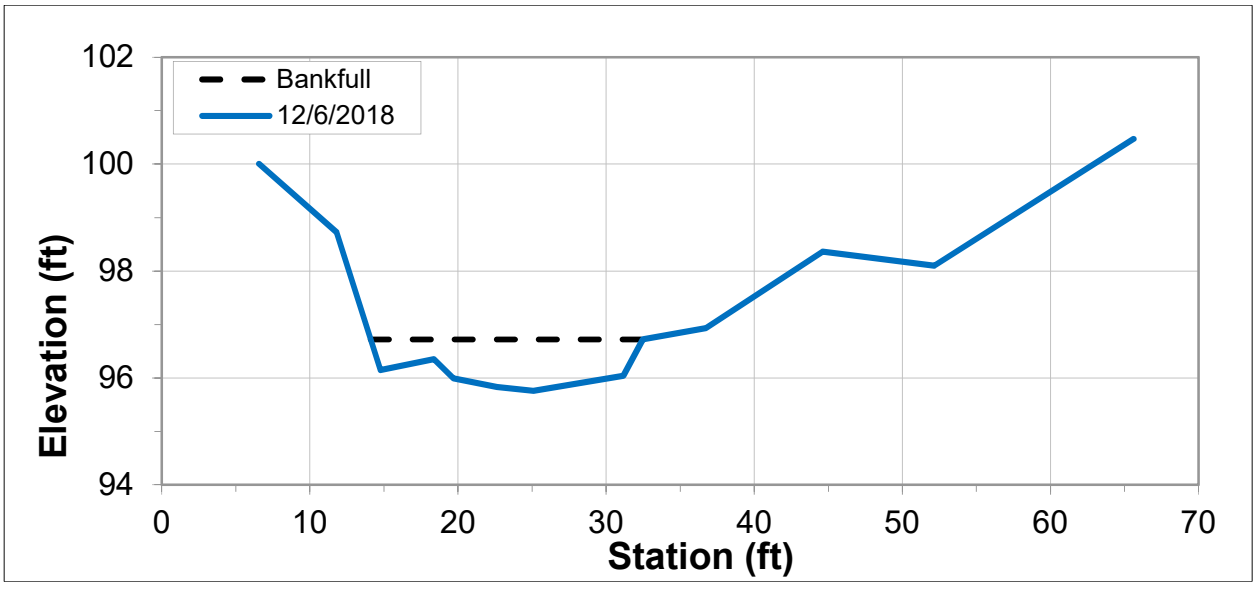


Figure C22: Cross section of site

Site: **4023 Shaw Rd.** (continued)

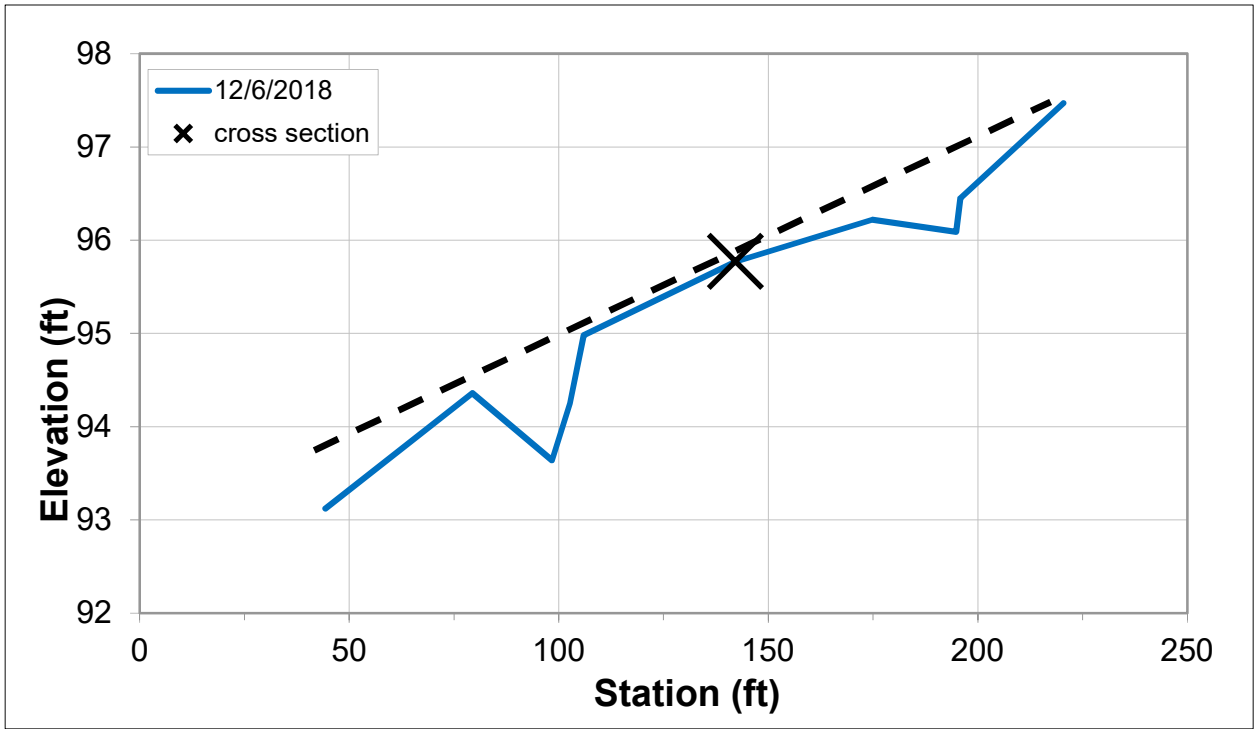


Figure C23: Profile of site

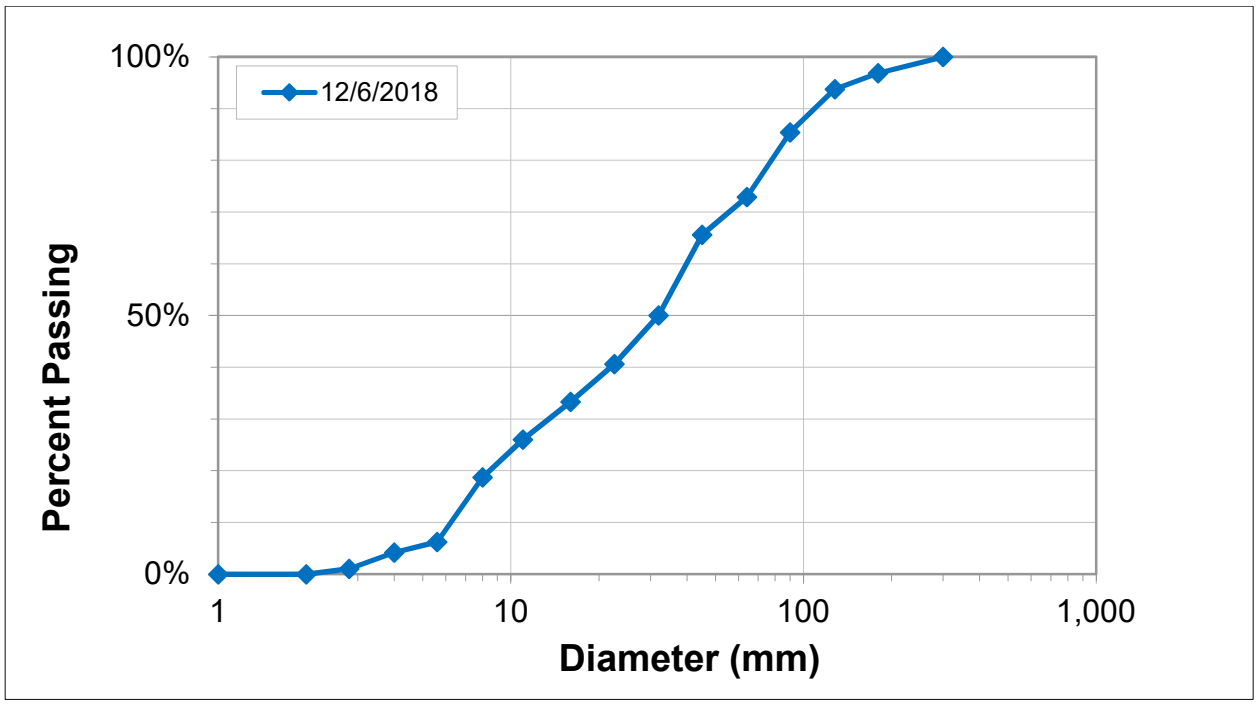


Figure C24: Bed material gradation at site

Site: **3139 Bath Rd.**

Imp: 2.05% (approximate, based on StreamStats/NLCD 2011 impervious dataset)

DA: 0.088 mi^2

Notes: Slope is steep (~6%). Site is in a confined valley with coarse bed and a decent bench. Bed material sample associated with more of a riffle than a step, which was also somewhat protected by the downstream grade control provided by the culvert, so the Qc associated with d50 is appropriate.

Date	BF Area (ft^2)	BF Depth (ft)	BF Top Width (ft)	Slope (ft/ft)	Pool/Riffle Ratio	d50 (mm)
12/6/2018	10.50	1.41	11.38	0.0593	0.10	61.63

Figure C25: Looking upstream. Cross section tape visible.

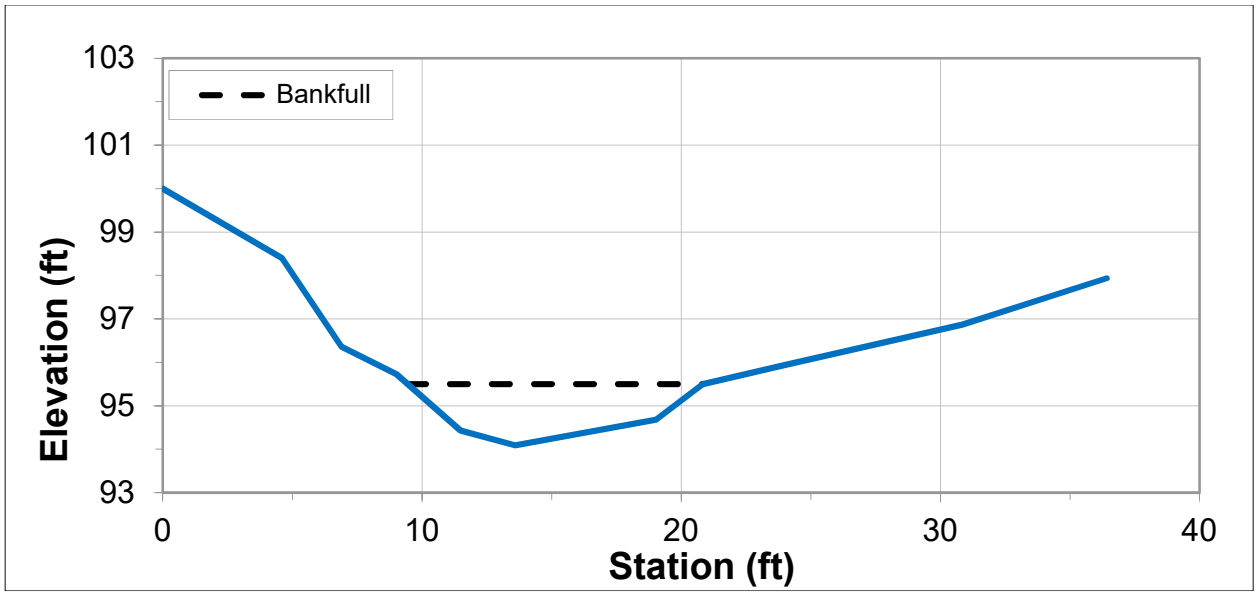


Figure C27: Cross section of site

Site: **3139 Bath Rd.** (continued)

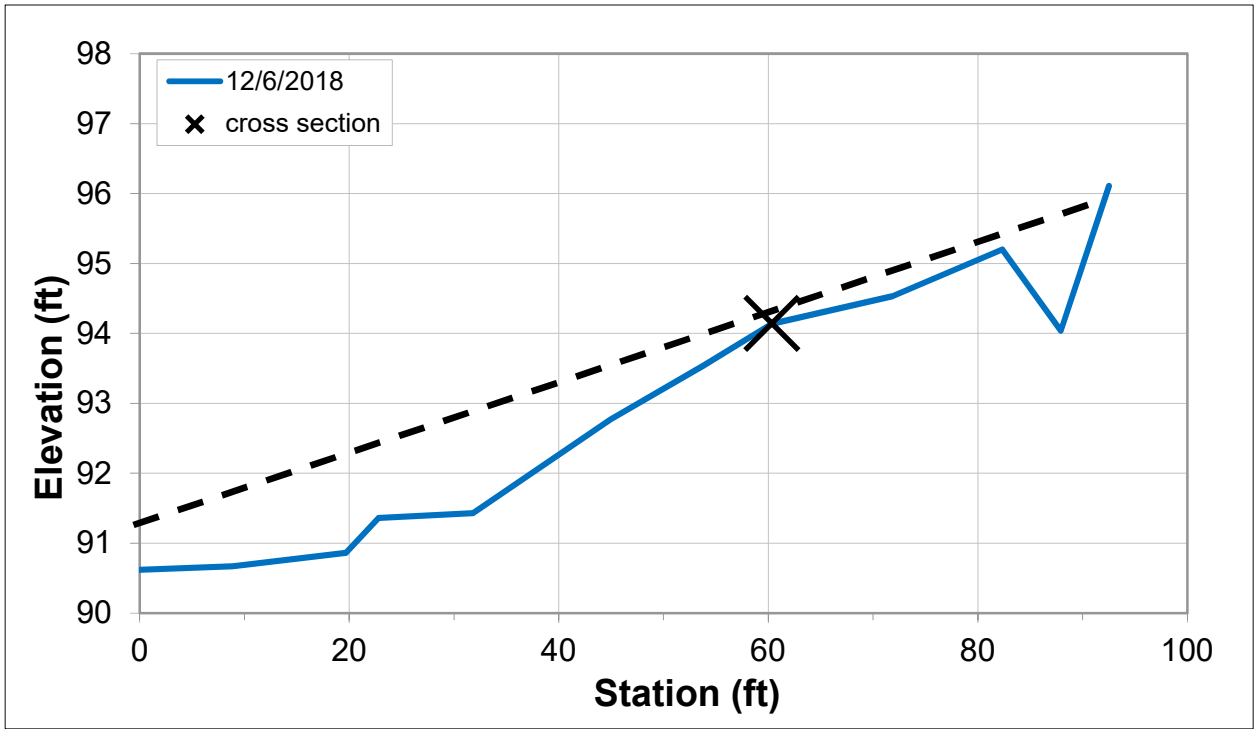


Figure C28: Profile of site

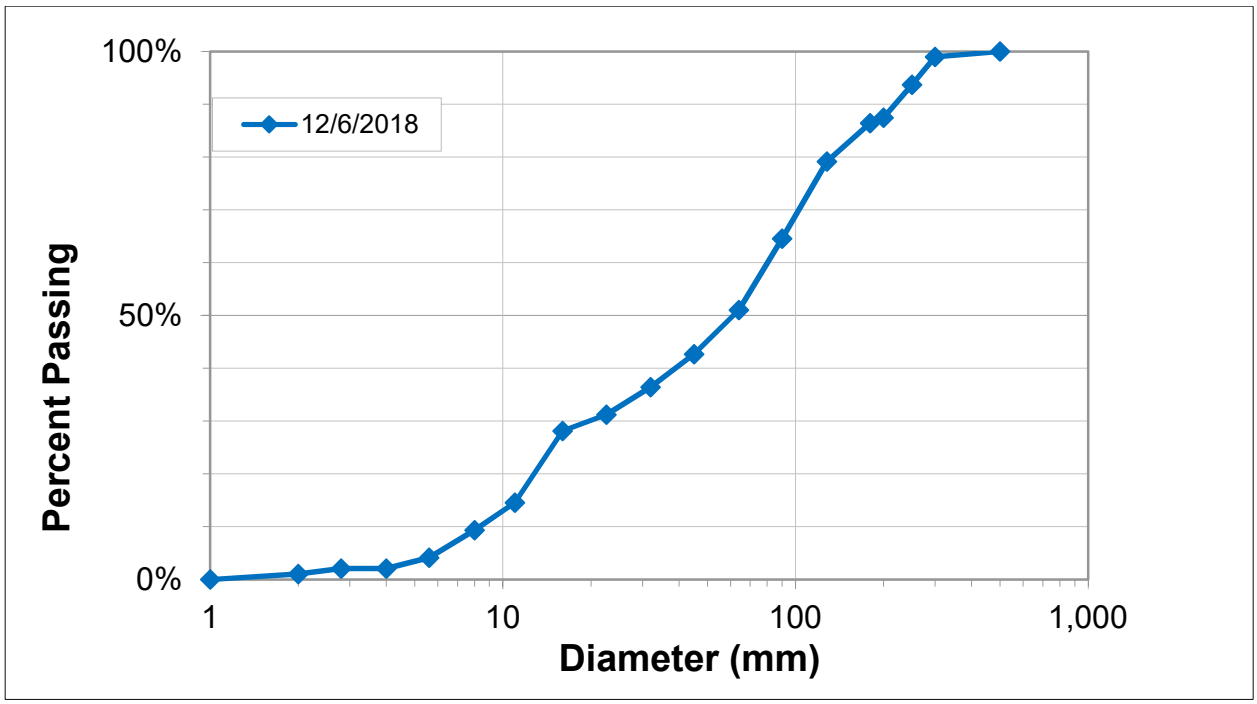


Figure C29: Bed material gradation at site

Site: **901 Timberline Dr.**

Imp: 7.04 (approximate, based on StreamStats/NLCD 2011 impervious dataset)

DA: 0.006 mi^2

Notes: Slope is very steep (10-15%) and highly unstable. There was not much of a representative bed material to count, but this riffle was somewhat protected by a downstream step, so d50 may be somewhat representative.

Date	BF Area (ft^2)	BF Depth (ft)	BF Top Width (ft)	Slope (ft/ft)	Pool/Riffle Ratio	d50 (mm)
12/6/2018	13.65	2.39	7.97	0.1213	-0.45	68.33

Figure C30: Looking upstream. Cross section tape visible.

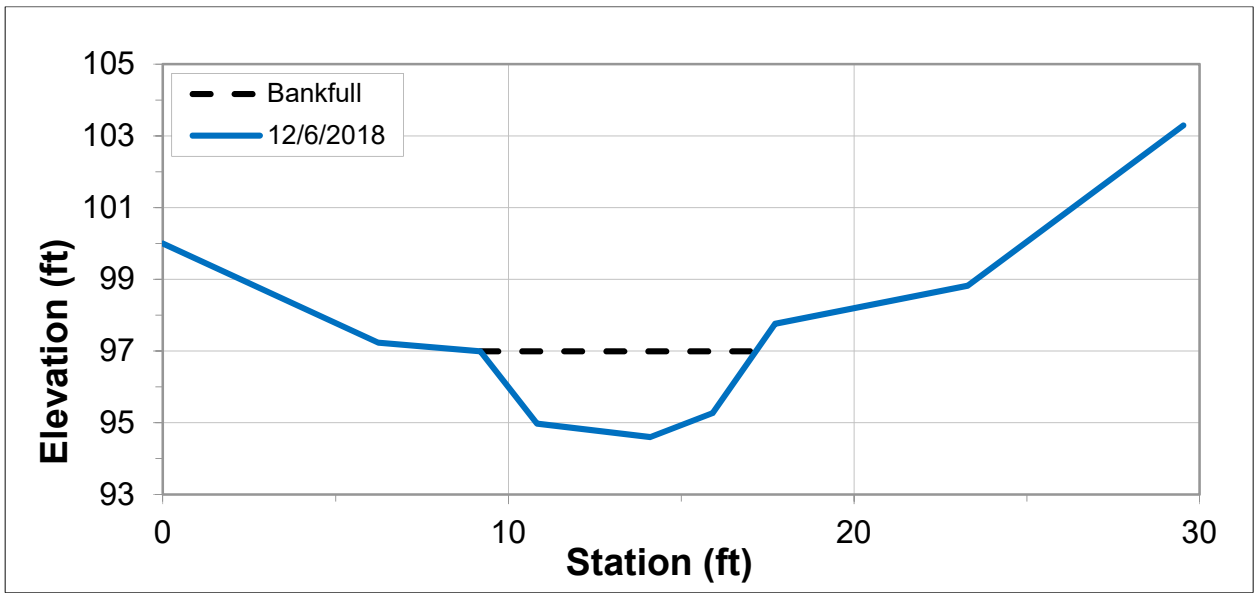


Figure C31: Cross section of site

Site: **901 Timberline Dr.** (continued)

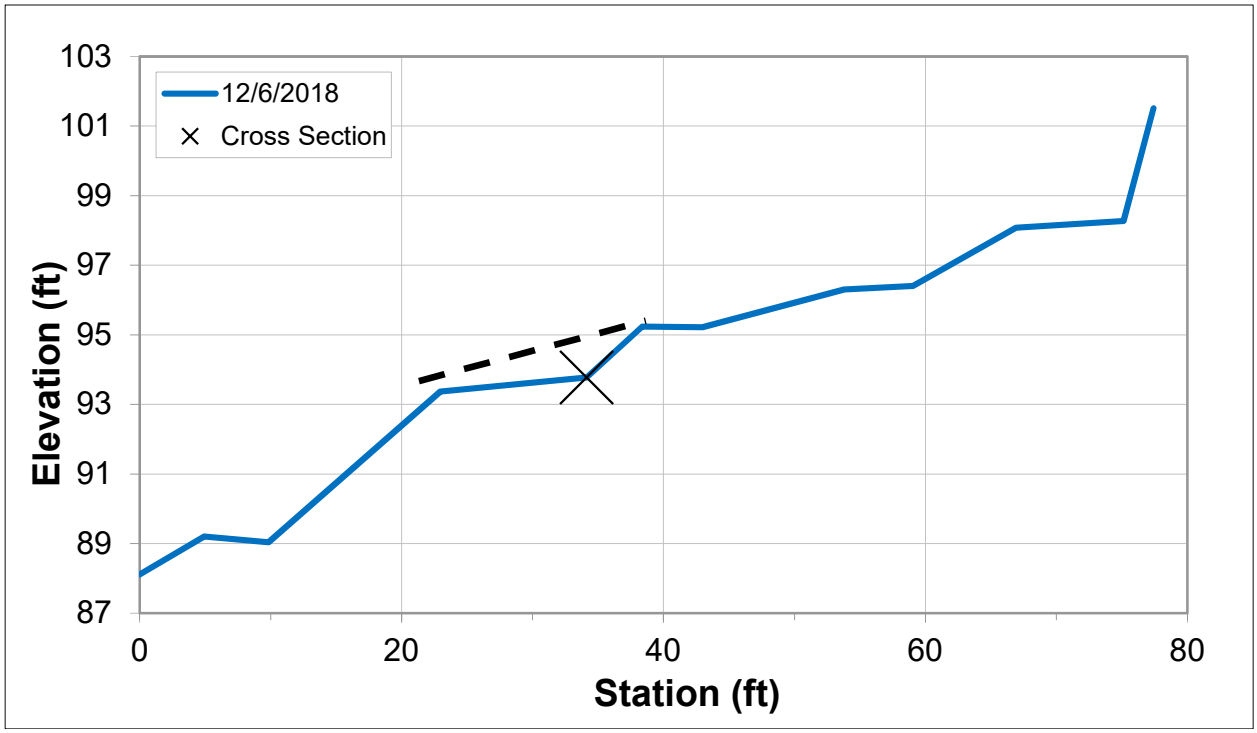


Figure C32: Profile of site

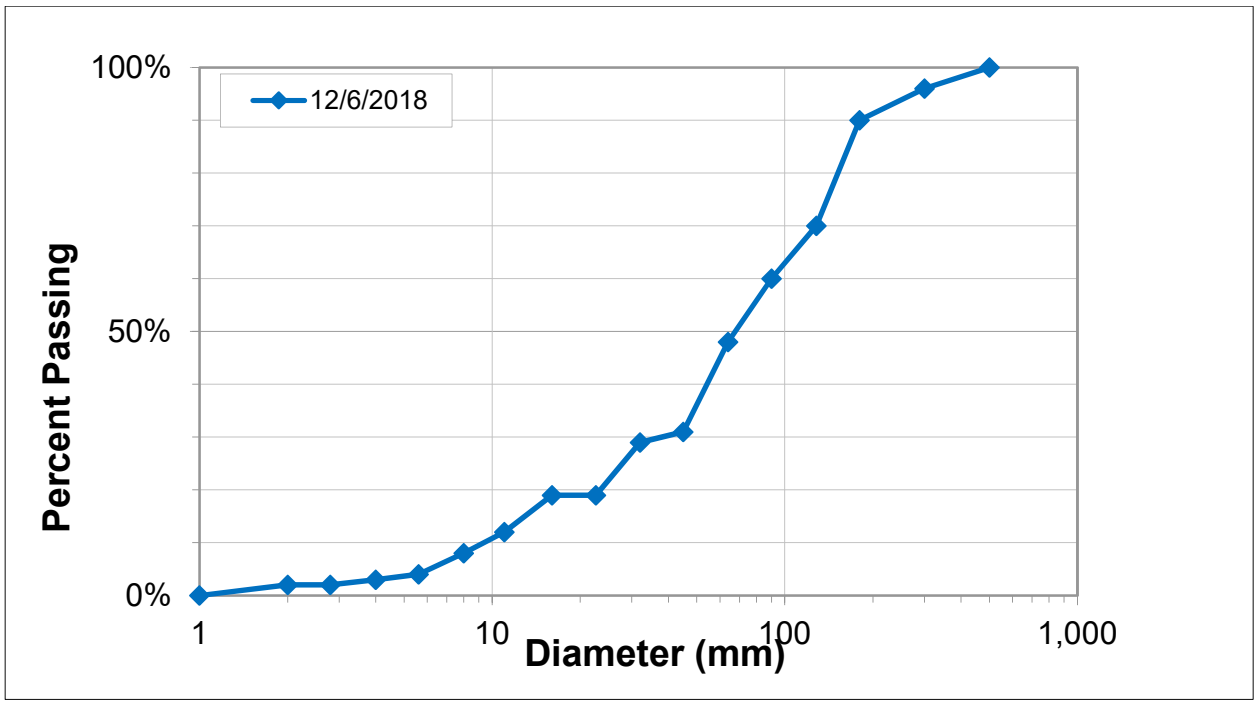


Figure C33: Bed material gradation at site

APPENDIX D

Conceptual Watershed Improvements

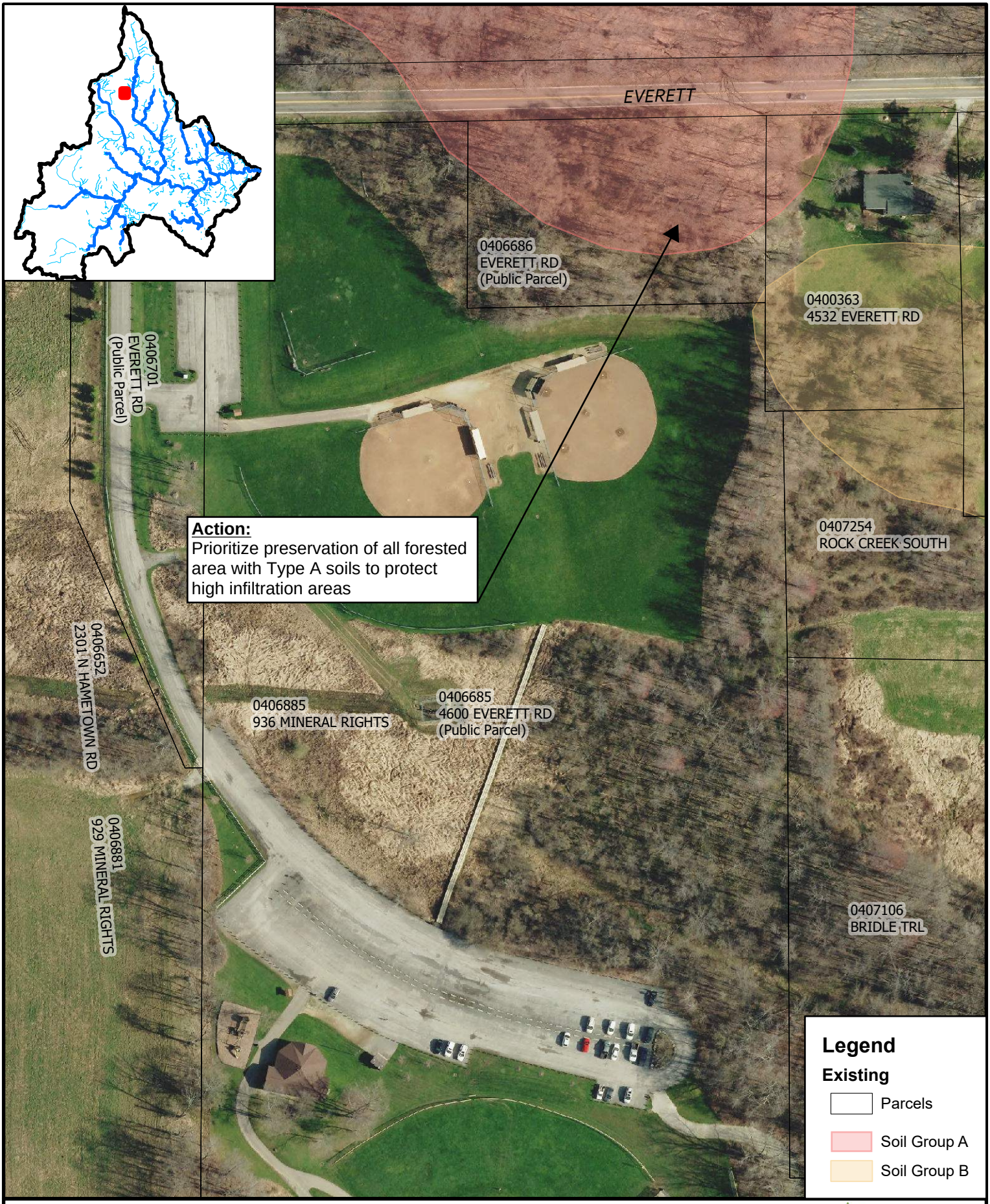
Category	Project Name	Issue Type	Address	Jurisdiction	Study and Design Costs	Construction Cost	Total Costs	Potentially Benefitted Residents	Relative Benefits to Public Water Resources
High Infiltration Areas	Bath Baseball Field Forest Preservation	Known	Everett Rd	Bath Township	$ -	$ -	$ -	North Fork catchment	Medium: Should maintain existing benefits
High Infiltration Areas	Bath Center Cemetery Forest Preservation	Known	1241 N Cleveland-Massillon Rd	Bath Township	$ -	$ -	$ -	North Fork catchment	Medium: Should maintain existing benefits
High Infiltration Areas	Bath Township Complex Forest Preservation	Known	3864 W Bath Rd	Bath Township	$ -	$ -	$ -	North Fork catchment	Medium: Should maintain existing benefits
High Infiltration Areas	Botzum Forest Preservation	Known	2928 Riverview Rd	Cuyahoga Falls	$ -	$ -	$ -	Yellow Creek catchment	Medium: Should maintain existing benefits
High Infiltration Areas	Hametown Road Parcels Forest Preservation	Known	N Hametown Rd	Bath Township	$ -	$ -	$ -	Idle Brook & Yellow Creek catchments	Medium: Should maintain existing benefits
High Infiltration Areas	Kniss Woods Nature Preserve Forest Preservation	Known	Southern Rd	Richfield Township	$ -	$ -	$ -	North Fork catchment	Medium: Should maintain existing benefits
High Infiltration Areas	O'Neill Woods Metropark Forest Preservation	Known	W Bath Rd	Bath Township	$ -	$ -	$ -	Waupaca Run & Yellow Creek catchments	Medium: Should maintain existing benefits
Infrastructure Improvement	1395 Partridge Culvert Study & Upsizing	Known	1395 Partridge Ln	Bath Township	$ 10,400	$ 9,000	$ 19,400	3 properties & public infrastructure	Low: Mitigate minor sediment source; asset protection
Infrastructure Improvement	Harmony Rd and Acacia Dr Storm Improvements	Known	Intersection of Harmony Rd and Acacia Dr	Bath Township	$ 17,250	$ 49,000	$ 66,250	3 properties & public infrastructure	Low: Asset protection
Infrastructure Improvement	Lakeview Dr Catch Basin Maintenance	Known	1900 Lakeview Dr	Bath Township	$ -	$ 7,000	$ 7,000	Public infrastructure	Low: Asset protection
Infrastructure Improvement	McVey Rd Outfall Stabilization	Extrapolated	1559, 1571 McVey Rd	Bath Township	$ 4,900	$ 7,000	$ 11,900	2 properties & public infrastructure	Low: Estimated to mitigate minor sediment source; asset protection
Infrastructure Improvement	Revere Rd 3 Culvert Study & Upsizing	Known	2327, 2332, and 2343 Revere Rd	Bath Township	$ 41,200	$ 171,000	$ 212,200	3 properties & public infrastructure	Low: Mitigate minor sediment source; asset protection
Infrastructure Improvement	Shaw Rd Outfall Repair	Known	4023 Shaw Rd	Bath Township	$ 5,400	$ 18,000	$ 23,400	1 property & public infrastructure	Low: Mitigate minor sediment source; asset protection
Infrastructure Improvement	Swan Lake Catch Basin Maintenance	Known	Swan Lake Dr	Copley Township	$ -	$ 3,000	$ 3,000	Public infrastructure	Low: Asset protection
Infrastructure Improvement	Woodthrush Storm Sewer Repair and Channel Stabilization	Known	3906 Woodthrush Rd	Bath Township	$ 26,400	$ 132,000	$ 158,400	2 properties & public infrastructure	High: Mitigates large sediment source
Optimization of Existing SCM	Arbour Green North Spillway and Retrofit Evaluation	Known	4735 Mallard Pond Dr	Bath Township	$ 10,200	$ 31,000	$ 41,200	West Fork catchment	Medium: Partially mitigates erosion/sediment downstream
Optimization of Existing SCM	Arbour Green South Flooding Risk Evaluation and Retrofit	Known	4728 Mallard Pond Dr	Bath Township	$ 9,000	$ 10,000	$ 19,000	West Fork catchment	Medium: Partially mitigates erosion/sediment downstream
Optimization of Existing SCM	Bonnebrook Dr Stream/Wetland Complex w/ Wet Weather Detention	Known	3320, 3362, 3376, and 3386 W Bath Rd	Bath Township	$ 37,400	$ 147,000	$ 184,400	Revere Run catchment	High: Potential to be optimized to reduce downstream erosion
Optimization of Existing SCM	Ghent Road Basin Spillway Evaluation and Enhancement	Known	Ghent Rd	Fairlawn/Akron	$ 45,400	$ 197,000	$ 242,400	Sourek Run & South Fork catchments	Low: Mitigates local safety risk
Optimization of Existing SCM	Solar Cir Basin Retrofit	Known	3109 Solar Cir	Bath Township	$ 11,200	$ 36,000	$ 47,200	Revere Run catchment	Medium: Partially mitigates erosion/sediment downstream
Creation of New SCM	Bath Community Park Bankfull Wetland and Detention	Known	1615 N Cleveland-Massillon Rd	Bath Township	$ 128,750	$ 515,000	$ 643,750	North Fork catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	Camp Christopher Bankfull Wetland	Known	1930 N Hametown Rd	Bath Township	$ 42,250	$ 169,000	$ 211,250	Bath Creek catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	Crystal Shores Bankfull Wetland	Known	Crystal Lake Rd	Bath Township	$ 45,250	$ 181,000	$ 226,250	Yellow Creek catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	Dunsha Bankfull Wetland 1	Known	Dunsha Rd	Granger Township	$ 8,500	$ 34,000	$ 42,500	West Fork catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	Dunsha Bankfull Wetland 2	Known	Dunsha Rd	Granger Township	$ 9,750	$ 39,000	$ 48,750	West Fork catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	Ghent Hills Amended Swales	Known	1164, 1186, and 1211 Ghent Hills Rd	Bath Township	$ 7,750	$ 31,000	$ 38,750	~5 properties in immediate vicinity	Medium: Partially mitigates erosion/sediment downstream
Creation of New SCM	Ghent Hills Detention	Known	1046 Ghent Hills Rd	Bath Township	$ 31,750	$ 127,000	$ 158,750	~3 properties in immediate vicinity	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	I-77 Rest Area Bankfull Wetland	Known	Spring Valley Rd	Bath Township	$ 10,750	$ 43,000	$ 53,750	Park Creek catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	Idle Brook Bankfull Wetland	Known	N Hametown Rd	Bath Township	$ 75,000	$ 500,000	$ 575,000	Idle Brook & Yellow Creek catchments	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	Medina Line Ponded Water Study and Improvements	Known	811 Medina Line Rd	Bath Township	$ 62,500	$ 210,000	$ 272,500	~5 properties in immediate vicinity	Low: Solution focused mostly on local flooding issues
Creation of New SCM	Nester Bankfull Wetland	Known	Crystal Lake Rd	Bath Township	$ 111,200	$ 556,000	$ 667,200	Yellow Creek catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	North Fork Bankfull Wetland	Known	Highlander Pkwy	Village of Richfield	$ 17,800	$ 89,000	$ 106,800	North Fork catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	O'Neill Woods Bankfull Wetland	Known	2175 Yellow Creek Rd	Bath Township	$ 62,000	$ 310,000	$ 372,000	Yellow Creek catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	Preston Bankfull Wetland	Known	Yellow Creek Rd	Bath Township	$ 62,500	$ 250,000	$ 312,500	Yellow Creek catchment	High: Potential to be optimized to reduce downstream erosion
Creation of New SCM	Ranchwood Stormwater Improvements	Known	4826 Ranchwood Rd	Bath Township	$ 272,500	$ 1,090,000	$ 1,362,500	~10 properties in immediate vicinity, plus potentially catchment-wide	Low: Solution focused mostly on local flooding issues

Category	Project Name	Issue Type	Address	Jurisdiction	Study and Design Costs	Construction Cost	Total Costs	Potentially Benefitted Residents	Relative Benefits to Public Water Resources
Creation of New SCM	Timberline Part A: Detention	Known	850 Timberline Dr	Bath Township	$ 32,700	$ 109,000	$ 141,700	1 downstream property	Medium: Partially mitigates erosion/sediment downstream
Creation of New SCM	Top of the Hill Site Detention	Known	1130, 1135, 1150, and 1170 Top of the Hill Rd	Bath Township	$ 20,000	$ 80,000	$ 100,000	~4 downstream properties	Medium: Partially mitigates erosion/sediment downstream
Creation of New SCM	West Fork Bankfull Wetland	Known	4568-4470 Granger Rd	Bath Township	$ 196,000	$ 980,000	$ 1,176,000	West Fork & Yellow Creek catchments	High: Potential to be optimized to reduce downstream erosion
Instability/downcutting in "Seasonal Channels"	Timberline Part B: Swale Stabilization	Known	901 Timberline Dr	Bath Township	$ 98,400	$ 492,000	$ 590,400	1 property	High: Mitigates large sediment source
Instability/downcutting in "Seasonal Channels"	Timberline Part C: Headcut Repair	Known	946 Timberline Dr	Bath Township	$ 6,200	$ 31,000	$ 37,200	1 property	Low: Mitigates small sediment souce; protects risk of migration
Instability/downcutting in "Seasonal Channels"	Timberline Part D: Tributary Stabilization	Extrapolated	3760 Granger Rd; 3919, 3933 Yellow Creek Rd	Bath Township	$ 237,600	$ 1,163,000	$ 1,400,600	3 properties	High: Estimated to mitigate large sediment source
Instability/downcutting in "Seasonal Channels"	Tributary Stabilization	Known	N Cleveland-Massillon Rd	Bath Township	$ 40,000	$ 200,000	$ 240,000	1 property	Medium: Mitigates moderate sediment source
Potentially Stabilized Streambanks	Crystal Lake Stream Re-alignment	Known	695 Crystal Lake Rd	Bath Township	$ 165,800	$ 829,000	$ 994,800	4 properties	High: Mitigates large sediment source
Potentially Stabilized Streambanks	Downtown Ghent Restoration	Known	Wye Rd	Bath Township	$ 366,200	$ 1,831,000	$ 2,197,200	10 propreties	High: Mitigates large sediment source
Potentially Stabilized Streambanks	Fox Chase Tributary Stabilization	Extrapolated	1356, 1378 Fox Chase Dr & 4172 Cliff Spur Dr	Bath Township	$ 147,600	$ 713,000	$ 860,600	3 properties	High: Estimated to mitigate large sediment source
Potentially Stabilized Streambanks	Lakeview Dr Stream Stabilization	Known	1900 Lakeview Dr	Bath Township	$ 55,000	$ 275,000	$ 330,000	1 property	Medium: Mitigates minor sediment source; improves upstream spillway stability
Potentially Stabilized Streambanks	Maple Dr. Hand-placed Log Stabilization	Known	End of Maple Dr	Village of Richfield	$ 5,800	$ 29,000	$ 34,800	1 property	Medium: Mitigates minor sediment source; improves habitat
Potentially Stabilized Streambanks	Ghent/Yellow Creek Tributary Stabilization	Extrapolated	3615 Yellow Creek Rd; 791 N Cleveland-Massillon Rd	Bath Township	$ 86,200	$ 406,000	$ 492,200	2 properties	Medium: Estimated to mitigate moderate sediment source
Potentially Stabilized Streambanks	Pine Point Drive Outfall Channel Stabilization	Extrapolated	699, 715 Pine Point Dr	Bath Township	$ 42,600	$ 188,000	$ 230,600	2 properties	Medium: Estimated to mitigate moderate sediment source; asset protection
Potentially Stabilized Streambanks	Stabilization near WWTP	Known	Granger Rd	Granger Township	$ 50,000	$ 250,000	$ 300,000	3 properties	Medium: Mitigates moderate sediment source
Potentially Stabilized Streambanks	Stone Gate Blvd Tributary Stabilization	Extrapolated	4793, 4805 Stone Gate Blvd	Bath Township	$ 151,200	$ 731,000	$ 882,200	2 properties	Medium: Estimated to mitigate moderate sediment source
Potentially Stabilized Streambanks	Trellis Green Stream Stabilization and Outfall Protection	Known	Trellis Green Dr	Bath Township	$ 38,200	$ 191,000	$ 229,200	3 properties	Medium: Mitigates moderate sediment source; improves basin stability
Potentially Stabilized Streambanks	West Creek Stabilization along Basin	Known	W Bath Rd	Bath Township	$ 57,400	$ 287,000	$ 344,400	2 properties	Medium: Mitigates moderate sediment source; improves basin stability
Potentially Stabilized Streambanks	Westmont Woods Subdivision Restoration	Known	276, 286, & 296 Fernway Dr; 4705, 4713, 4723, 4733, 4743, & 4753 Forest Brook Dr	Copley Township	$ 201,000	$ 1,005,000	$ 1,206,000	9 properties	Medium: Mitigates moderate sediment source
Potentially Partially Stabilized Streambanks	Bath Creek Select Stream Stabilization	Known	4012 W Bath Rd., Rambling Way, Hughestowne Dr., & Robinwood Hills to Cleve-Mass	Bath Township	$ 277,000	$ 1,385,000	$ 1,662,000	10 propreties	High: Mitigates large sediment source
Potentially Partially Stabilized Streambanks	Lower South Fork Tributary Stabilization	Extrapolated	746 Treecrest & 3044 Yellow Creek Rd	Bath Township	$ 355,000	$ 1,750,000	$ 2,105,000	2 properties	High: Estimated to mitigate large sediment source
Potentially Partially Stabilized Streambanks	Merrill's Run Stabilization	Known	1170 Top of The Hill Rd, 2801 Yellow Creek Rd, and 2820, 2825 Roundhill Rd	Bath Township	$ 660,000	$ 3,300,000	$ 3,960,000	4 properties	High: Mitigates large sediment source
Potentially Partially Stabilized Streambanks	North Fork Stream Re-alignment	Known	N Cleveland-Massillon Rd	Bath Township	$ 110,000	$ 550,000	$ 660,000	3 properties	High: Mitigates large sediment source
Potentially Partially Stabilized Streambanks	Revere Rd Stabilization	Known	1395 and 1415 Sugar Knoll Dr	Bath Township	$ 80,000	$ 400,000	$ 480,000	2 properties	High: Mitigates large sediment source
Potentially Partially Stabilized Streambanks	Revere Run Select Stream Stabilization	Known	From Walnut Ridge Rd and Bonnebrook Dr to 3170 W Bath Rd	Bath Township	$ 220,000	$ 1,100,000	$ 1,320,000	9 properties	High: Mitigates large sediment source
Potentially Partially Stabilized Streambanks	Revere Rd to Yellow Creek Tributary Stabilization	Extrapolated	1210, 1270, 1290 Revere Rd & 2512, 2514 Yellow Creek Rd	Bath Township	$ 542,600	$ 2,688,000	$ 3,230,600	6 properties	High: Estimated to mitigate large sediment source
Potentially Partially Stabilized Streambanks	Ridge Drive Tributary Stabilization	Extrapolated	661 Highlands Dr & 3141 S Ridge Dr	Bath Township	$ 102,600	$ 488,000	$ 590,600	2 properties	Medium: Estimated to mitigate moderate sediment source
Potentially Partially Stabilized Streambanks	Timber Creek Drive Tributary Stabilization [(a)]	Extrapolated	637, 653, 665 Timber Creek Dr & 3832 Yellow Creek Rd	Bath Township	$ 186,200	$ 906,000	$ 1,092,200	5 properties	High: Estimated to mitigate large sediment source
Potentially Partially Stabilized Streambanks	Top of the Hill North Tributary Stabilization	Extrapolated	1130, 1150, 1170 Top of the Hill Rd & 2820 Roundhill Rd	Bath Township	$ 245,000	$ 1,200,000	$ 1,445,000	4 properties	High: Estimated to mitigate large sediment source
Potentially Partially Stabilized Streambanks	Top of the Hill South Tributary Stabilization	Extrapolated	2851, 2881, 2901 Yellow Creek Rd and 1155 Top of the Hill Rd	Bath Township	$ 267,600	$ 1,313,000	$ 1,580,600	3 properties	High: Estimated to mitigate large sediment source
Potentially Partially Stabilized Streambanks	West Creek Tributary to Hametown Rd Stabilization	Extrapolated	1081 N Hametown Rd; Shaw Rd.	Bath Township	$ 77,600	$ 363,000	$ 440,600	2 properties	Medium: Estimated to mitigate moderate sediment source
Programmatic/ Non-structural	Homeowner Education - Septic Maintenance	n/a	n/a	n/a	$ 15,000	$ -	$ 15,000	Watershed-wide	Medium: Potential to mitigate bacteria discharges
Programmatic/ Non-structural	Homeowner Education - Streamside Management	n/a	n/a	n/a	$ 36,000	$ -	$ 36,000	Watershed-wide	Medium/High: Potential to mitigate moderate to large sediment sources
Programmatic/ Non-structural	Homeowner Education - Onsite Stormwater Management	n/a	n/a	n/a	$ 36,000	$ -	$ 36,000	Watershed-wide	Low: Flooding and standing water focus
Programmatic/ Non-structural	Staff Training - Streamside Management	n/a	n/a	n/a	$ 8,000	$ -	$ 8,000	Watershed-wide	Medium/High: Potential to mitigate moderate to large sediment sources

Category	Project Name	Issue Type	Address	Jurisdiction	Study and Design Costs	Construction Cost	Total Costs	Potentially Benefitted Residents	Relative Benefits to Public Water Resources
Programmatic/ Non-structural	Yellow Creek Nine-element Nonpoint Source Implementation Strategic Plan (NPS-IS Plan)	n/a	n/a	n/a	$ 30,000	$ -	$ 30,000	Watershed-wide	High: Potential to highlight high-impact projects and receive future OEPA funding
Programmatic/ Non-structural	Live Stake Program	n/a	n/a	n/a	$ 25,000	$ -	$ 25,000	Watershed-wide	Medium/High: Potential to mitigate moderate to large sediment sources
Programmatic/ Non-structural	Culvert Mapping	n/a	n/a	n/a	$ 45,000	$ -	$ 45,000	Watershed-wide	Low: Asset protection
Programmatic/ Non-structural	Culvert Inspections	n/a	n/a	n/a	$ 100,000	$ -	$ 100,000	Watershed-wide	Low/Medium: Asset protection; Potential to identify minor sediment sources to mitigate
Programmatic/ Non-structural	Storm Sewer Mapping	n/a	n/a	n/a	$ 45,000	$ -	$ 45,000	Watershed-wide	Low: Asset protection
Programmatic/ Non-structural	Stormwater Basin Inspections	n/a	n/a	n/a	$ 100,000	$ -	$ 100,000	Watershed-wide	Low/Medium: Asset protection; Potential to identify minor sediment sources to mitigate
Programmatic/ Non-structural	Detention Basin Retrofit Opportunities Evaluation	n/a	n/a	n/a	$ 40,000	$ -	$ 40,000	Watershed-wide	Medium/High: Potential to mitigate large sediment sources if opportunties exist
Programmatic/ Non-structural	Follow-up - Detention Basin Retrofit Implementation	n/a	n/a	n/a	$ -	$ 200,000	$ 200,000	Watershed-wide	Medium/High: Potential to mitigate large sediment sources if opportunties exist
Programmatic/ Non-structural	Standard Detail Development for Outfall Protection with Rock	n/a	n/a	n/a	$ 10,000	$ -	$ 10,000	Watershed-wide	Low: Asset protection
Programmatic/ Non-structural	Rules and Regulations Review	n/a	n/a	n/a	$ 5,000	$ -	$ 5,000	Watershed-wide	High: Incorporate Qcritical to mitigate downstream erosion
Programmatic/ Non-structural	Plan Review	n/a	n/a	n/a	$ 32,000	$ -	$ 32,000	Watershed-wide	Medium/High: Potential to mitigate large sediment sources with apprpriate designs
Programmatic/ Non-structural	Onsite Drainage Complaint Consultant	n/a	n/a	n/a	$ 45,000	$ -	$ 45,000	Watershed-wide	Medium/High: Potential to mitigate moderate to large sediment sources
Programmatic/ Non-structural	Other/Management/Planning	n/a	n/a	n/a	$ 500,000	$ -	$ 500,000	Watershed-wide	To be determined

[(a)] This stream segment is among the upper reaches of the Wye Road Flood Mitigation and Alternatives Study (ms consultants, 2019), and coincides with solution(s) presented for the study area. Solutions in the Wye Road study range from $250,000 to $600,000.

Name	Issue Type	Address	Jurisdiction	Assumed Responsible Party	Note
Bridge and Culvert Inspections	Known	Watershed-wide	Watershed-wide	Transportation Dept.	Numerous bridges and culverts exhibited potential signs of instability during visual assessment
Routine Dam Inspections	Known	Watershed-wide	Watershed-wide	Owners	Apparent instability on several dams during visual assessment
Bonnebrook Dr Gabion Instability	Known	3320 W Bath Rd	Bath Township	Transportation Dept.	Gabion appears to be slumping with erosion on top left
Cleve-Mass Bridge at North Fork	Known	1018 N Cleveland-Massillon Rd	Bath Township	Transportation Dept.	Bridge angles flow directly into stream bank on DS slide
Eastern Granger Rd Culvert Protection	Extrapolated	4695-4700 Granger Rd	Bath Township	Transportation Dept.	Culvert should be visited. Most of the culverts we saw had some instability indicators
Western Granger Rd Culvert Protection	Extrapolated	4734-4737 Granger Rd	Bath Township	Transportation Dept.	Culvert should be visited. Most of the culverts we saw had some instability indicators
Martin Rd Culvert Instability	Extrapolated	2687 Martin Rd	Bath Township	Transportation Dept.	It appears unstable and that it was already fixed once, per Google Street View
Medina Line Rd Riprap Instability	Known	693 Medina Line Rd	Bath Township	Transportation Dept.	Exposed geotextile, mobile riprap? on bank
N Hametown Channel Instability	Known	N Hametown Rd	Bath Township	Power Company	Power pole at risk as well as basin with eroded, steep bank
North Fork Instability at Cleve-Mass	Known	890 Cleveland-Massillon Rd	Bath Township	Transportation Dept.	Steep bank, instability risk. Protect roadway with riprap at toe of slope
Revere Rd Riprap Instability	Known	Revere Rd	Bath Township	Transportation Dept.	Undercut riprap along road should be fixed
Sourek Rd Swale Instability	Known	Sourek Rd	Bath Township	Power Company	Ditch erosion, risk to powerline
Swan Lake Outlet Improvement	Known	4430 Swan Lake Rd	Copley Township	HOA/Resident	Outlet structure provides little to no protection from entering the structure. Safety barrier recommended.
Tributary Instability at Wye Rd	Extrapolated	Wye Rd, south of Yellow Creek Rd	Bath Township	Transportation Dept.	Stream appears in close proximity to roadway per Google Earth
Yellow Creek Exposed Gas Main	Known	2700 Yellow Creek Rd	Bath Township	Gas Company	Exposed gas main
Private Residence: 2226 W. Bath Rd Instability	Known	2226 W. Bath Rd	Cuyahoga Falls	Resident	House at risk. ~30-ft tall vertical bank
Private Residence: 2364 Berrywood Dr Instability	Known	2364 Berrywood Dr	Bath Township	Transportation Dept., Resident	Mass wasting threatening roadway, houses
Private Residence: 4023 Shaw Rd Instability	Known	4023 Shaw Rd	Bath Township	Resident	Corner of house may only be ~10'+/- from top of failing bank.
Private Residence: 4191 Janwood Dr Instability	Known	4191 Janwood Dr	Copley Township	Resident	House at risk
Private Residence: 4595 Larkspur Ln N Instability	Extrapolated	4595 Larkspur Ln N	Bath Township	Resident	Relatively close proximity to houses with steep contours. Similar latitude to identified issues D/S of Ranchwood
Private Residence: 4737 Granger Rd Instability	Extrapolated	4737 Granger Rd	Bath Township	Resident	Relatively close proximity to house with steep contours.
Private Residence: 750 Spring Water Dr Instability	Extrapolated	750 Spring Water Dr	Bath Township	Resident	Looks unstable in aerial with house close by



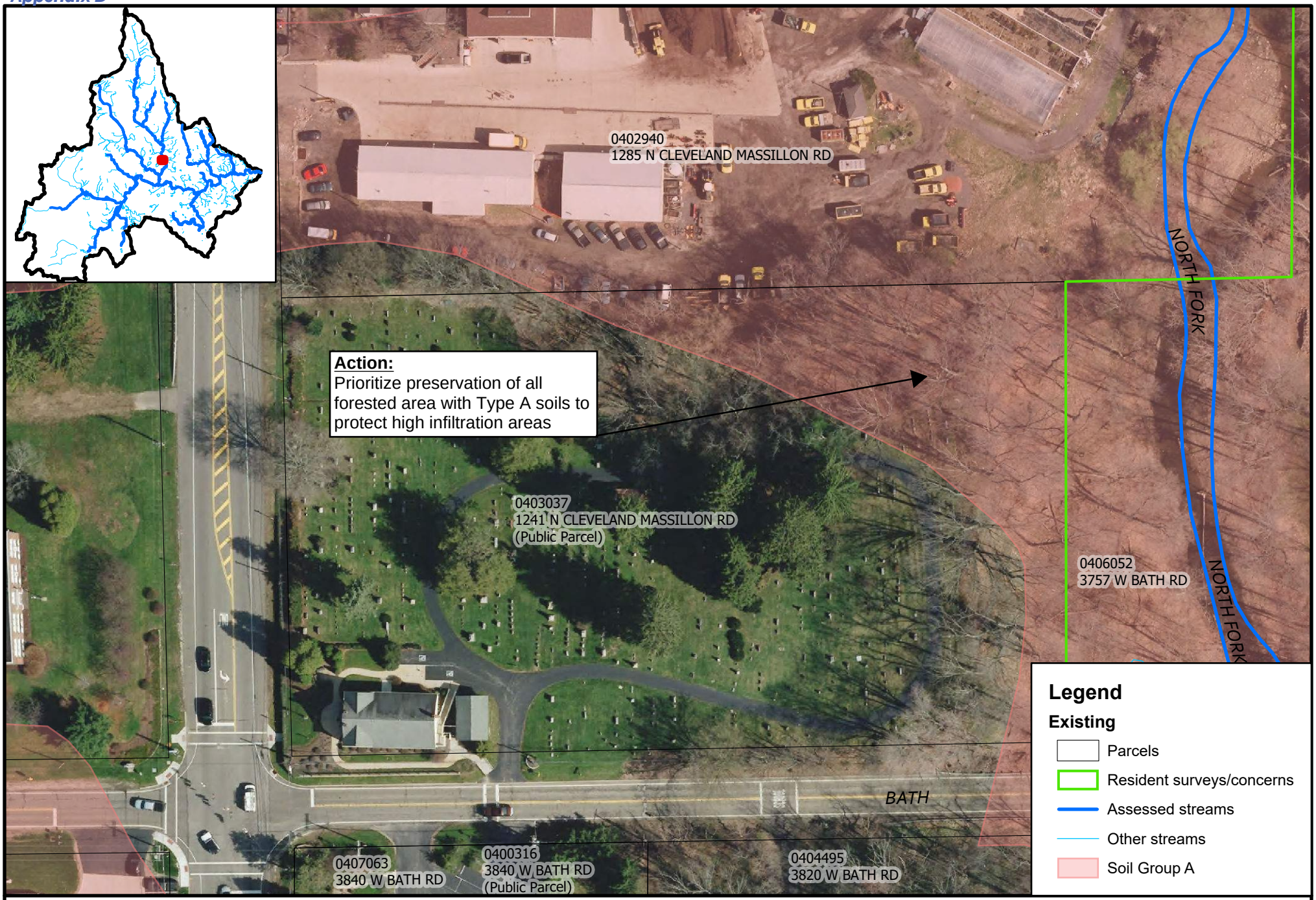
HIGH INFILTRATION AREA PROTECTION

BATH BASEBALL FIELD FOREST PRESERVATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



HIGH INFILTRATION AREA PROTECTION

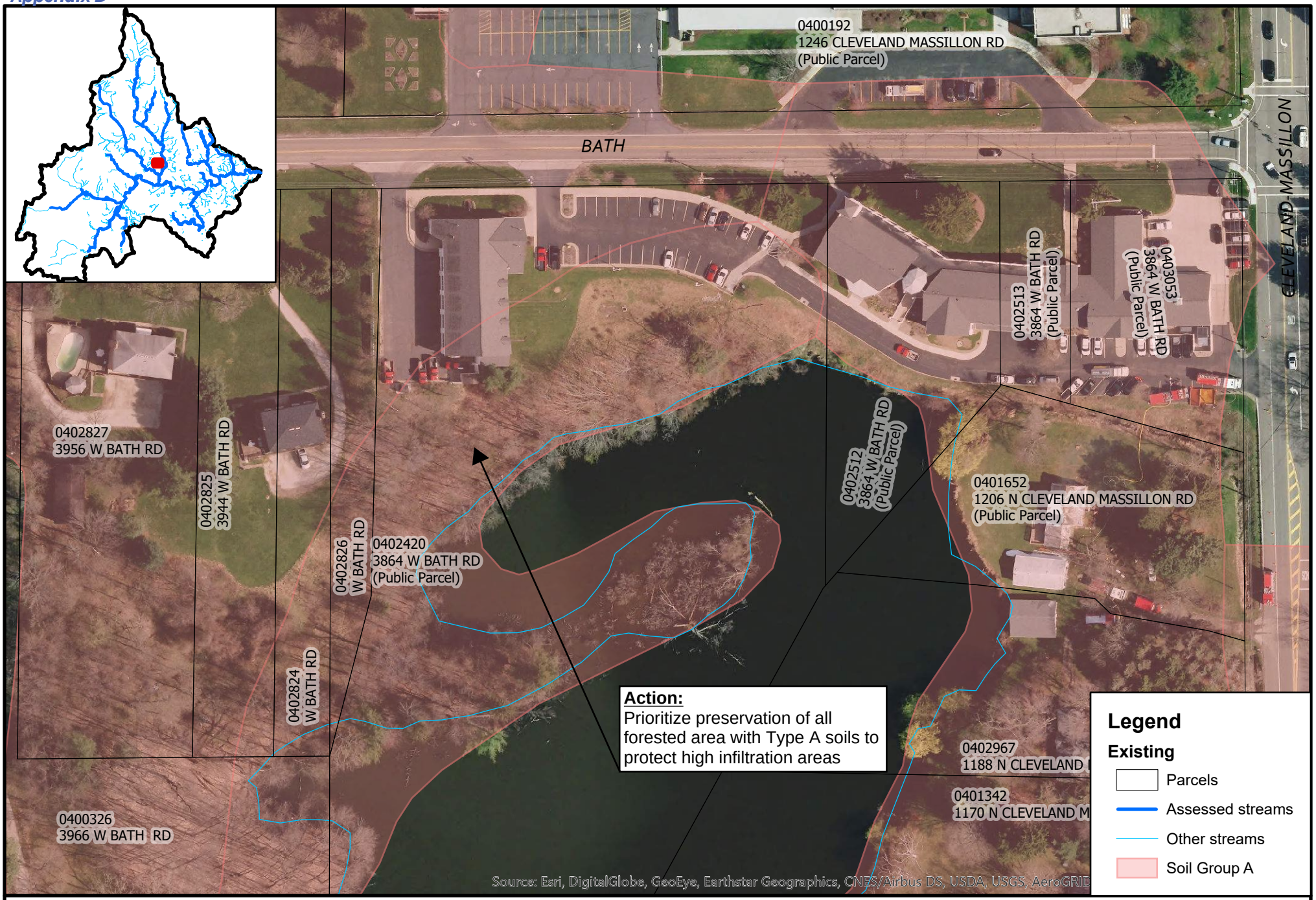
BATH CENTER CEMETERY FOREST PRESERVATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Friday, July 5, 2019



HIGH INFILTRATION AREA PROTECTION

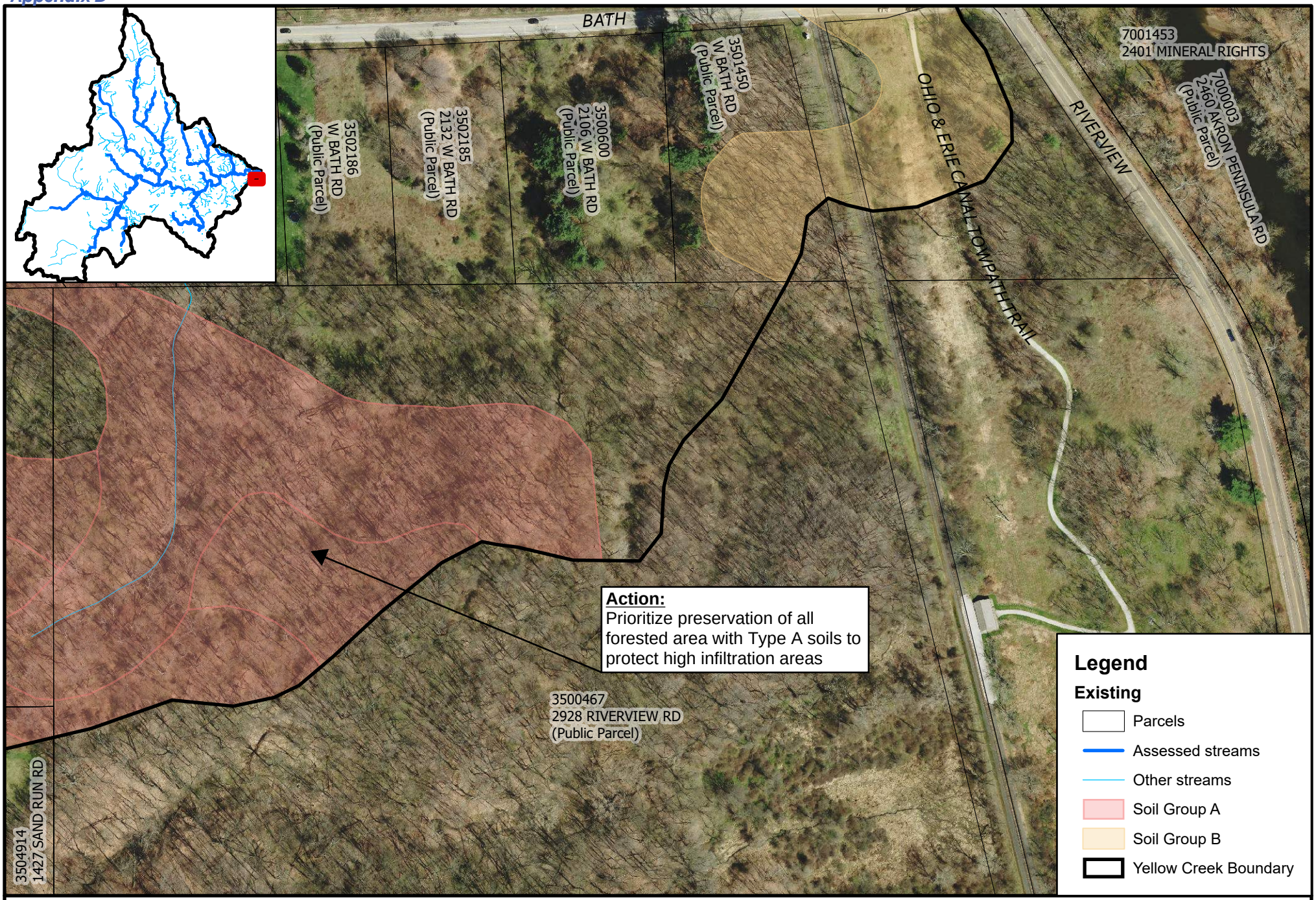
BATH TOWNSHIP COMPLEX FOREST PRESERVATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Thursday, August 15, 2019



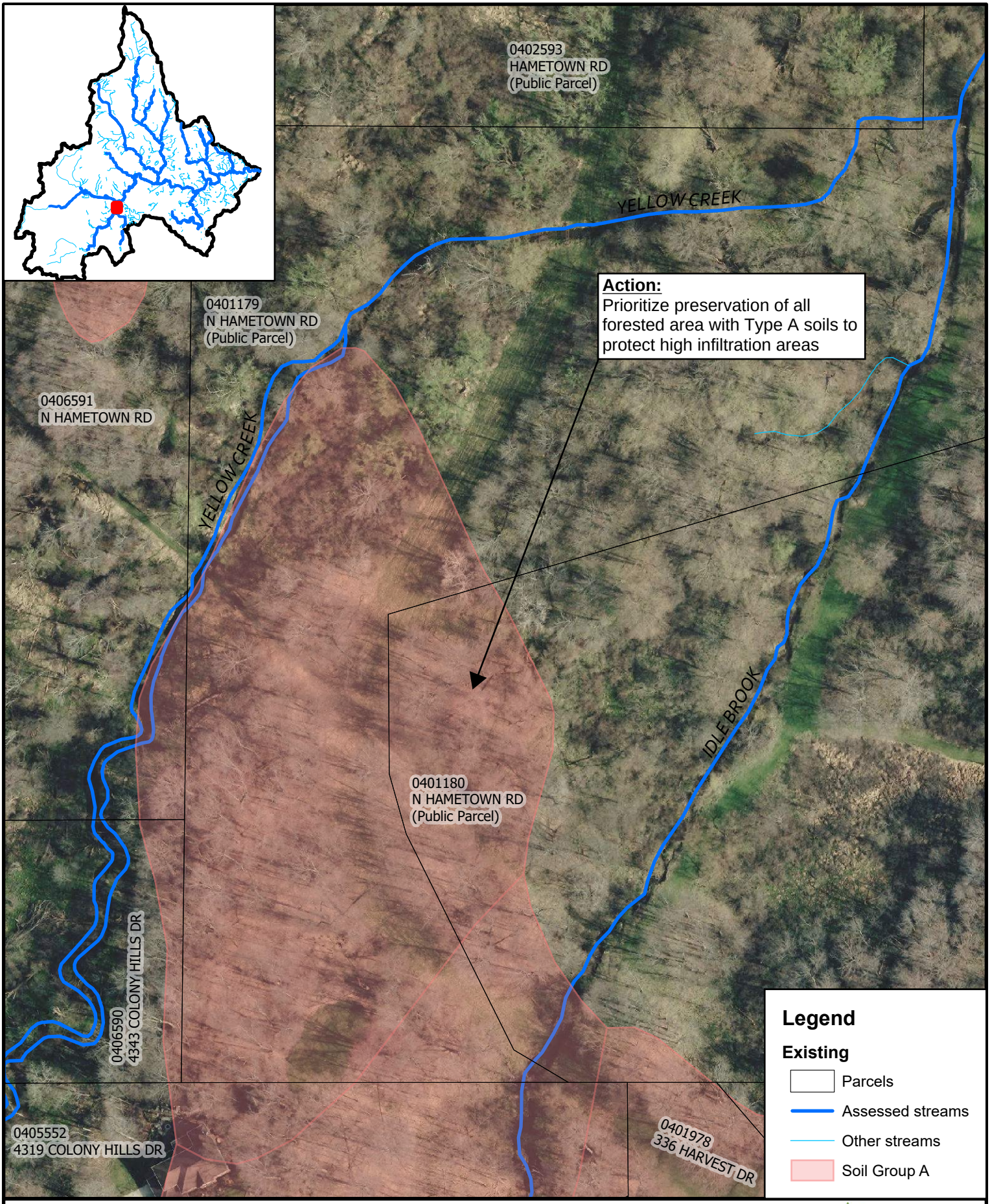
HIGH INFILTRATION AREA PROTECTION

BOTZUM FOREST PRESERVATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



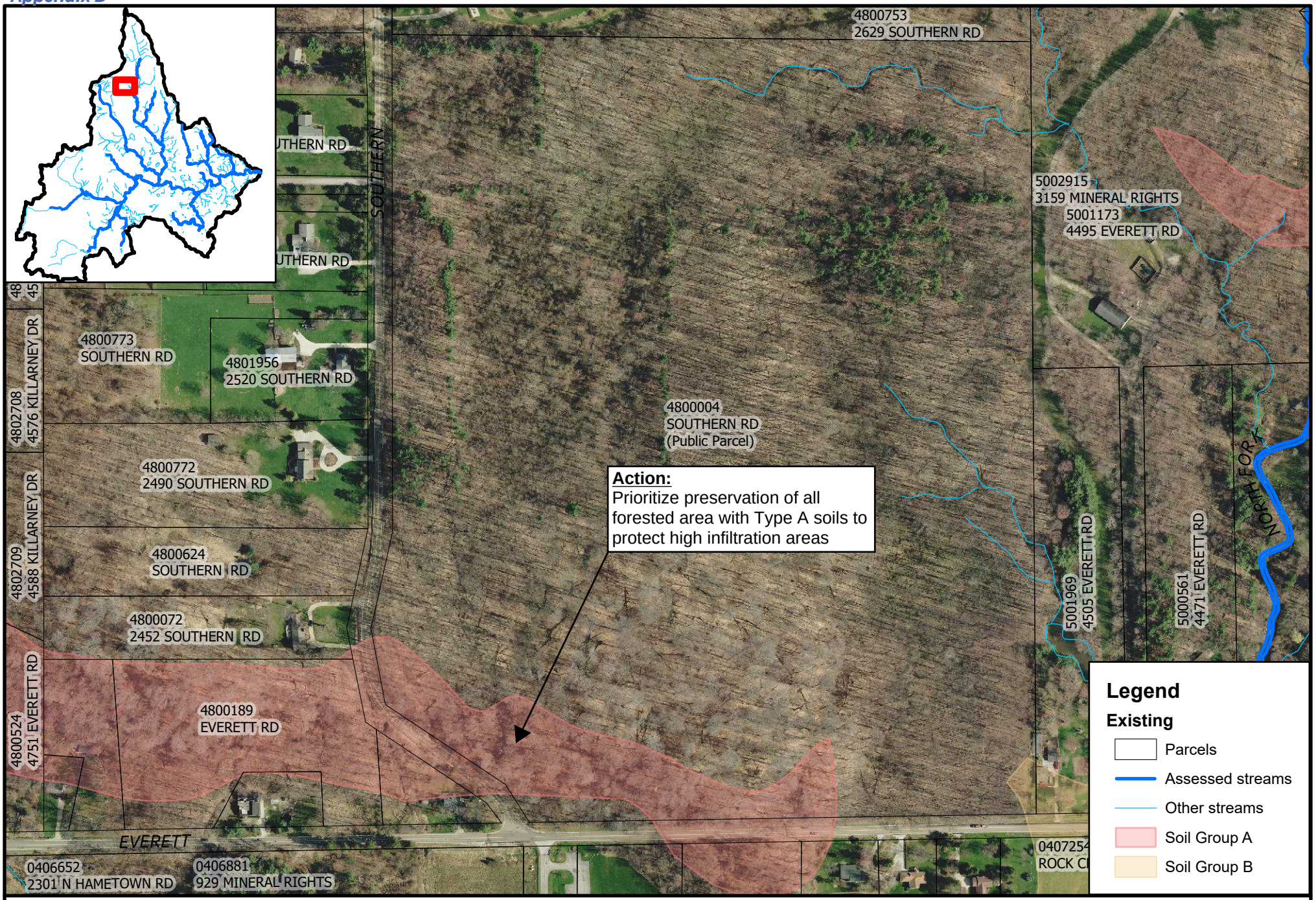
HIGH INFILTRATION AREA PROTECTION

HAMETOWN ROAD PARCELS FOREST PRESERVATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



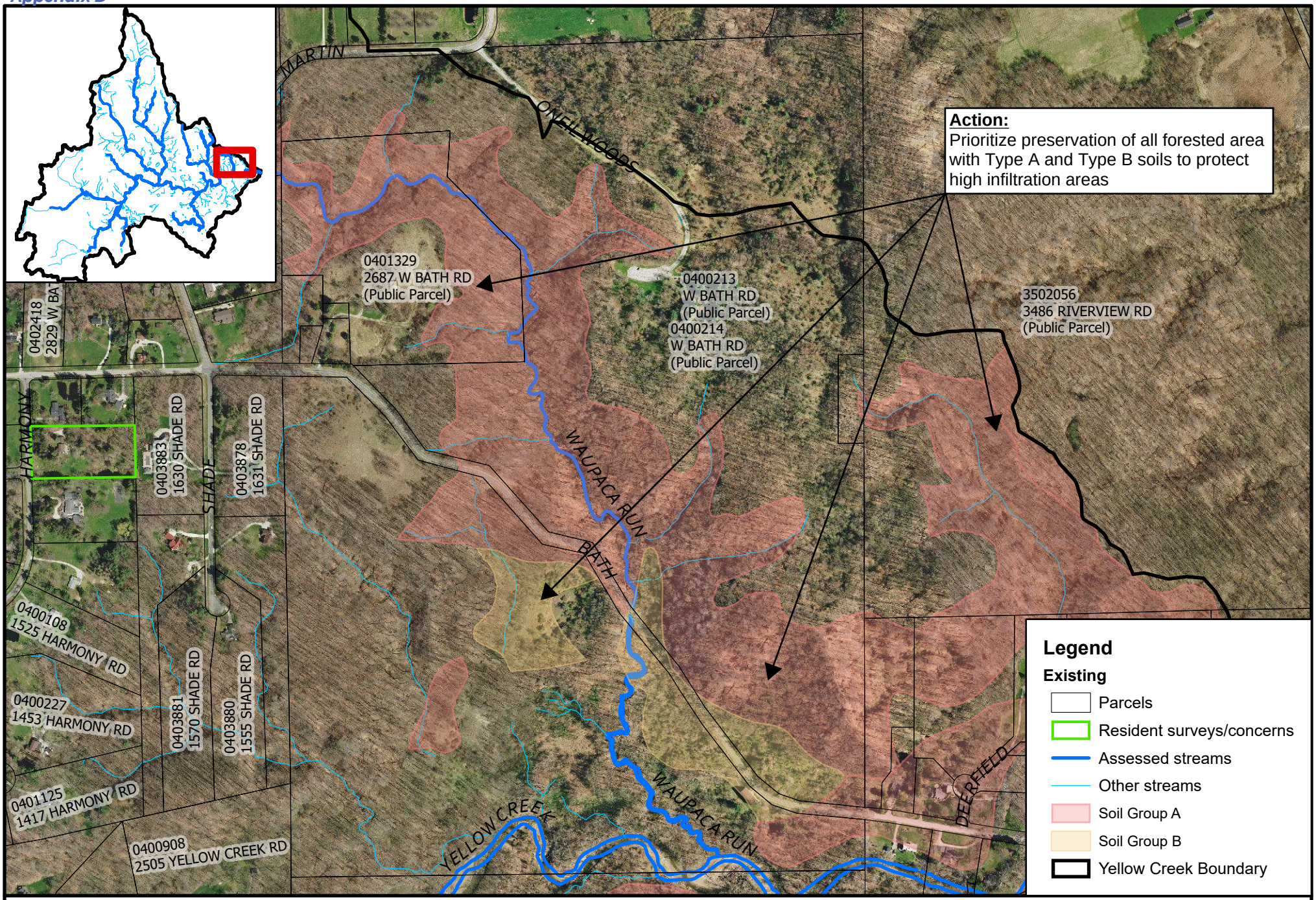
HIGH INFILTRATION AREA PROTECTION

KNISS WOODS NATURE PRESERVE FOREST PRESERVATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

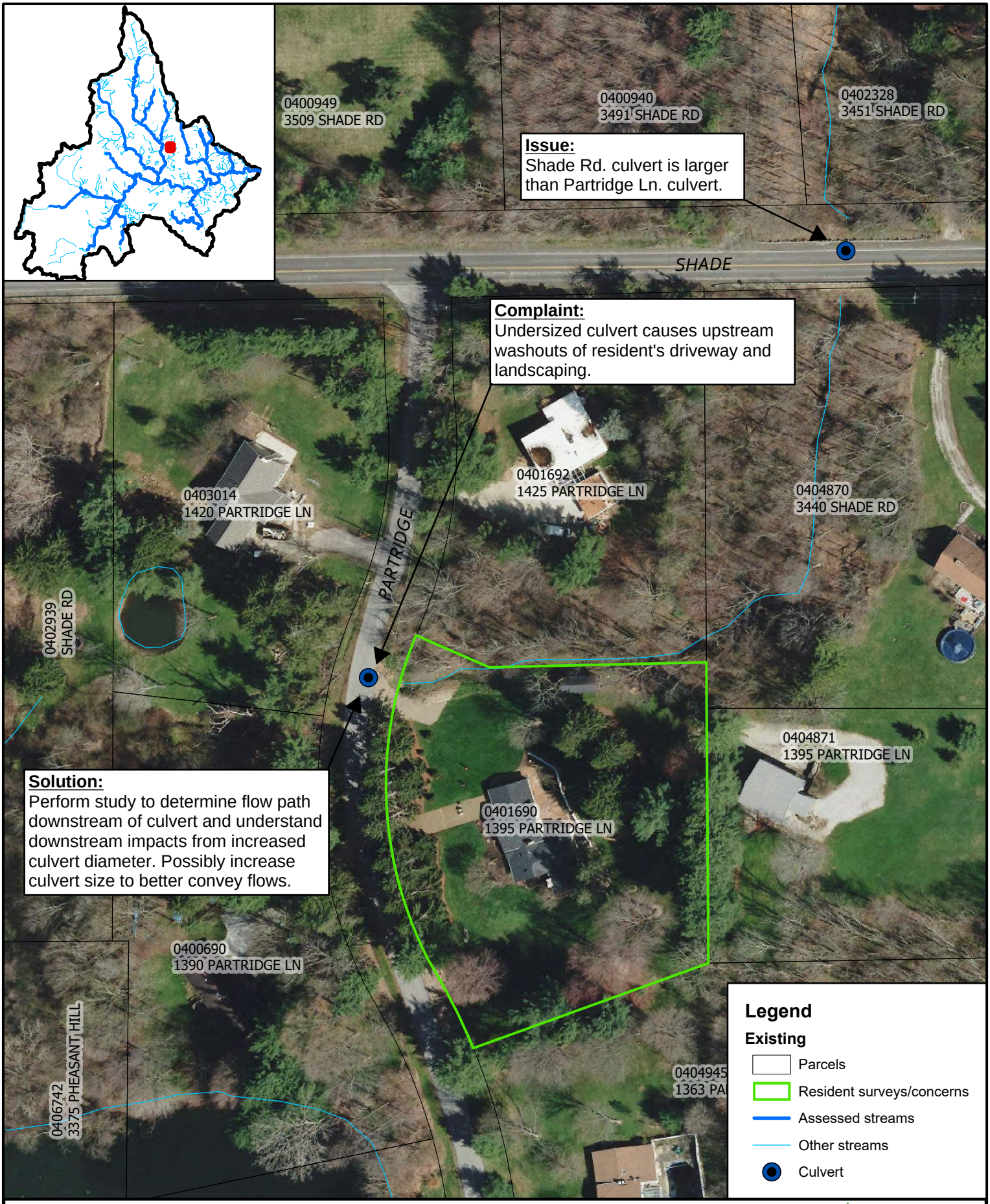
Sustainable Streams LLC



HIGH INFILTRATION AREA PROTECTION
O'NEILL WOODS METROPARK FOREST PRESERVATION
BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT
SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Friday, July 19, 2019



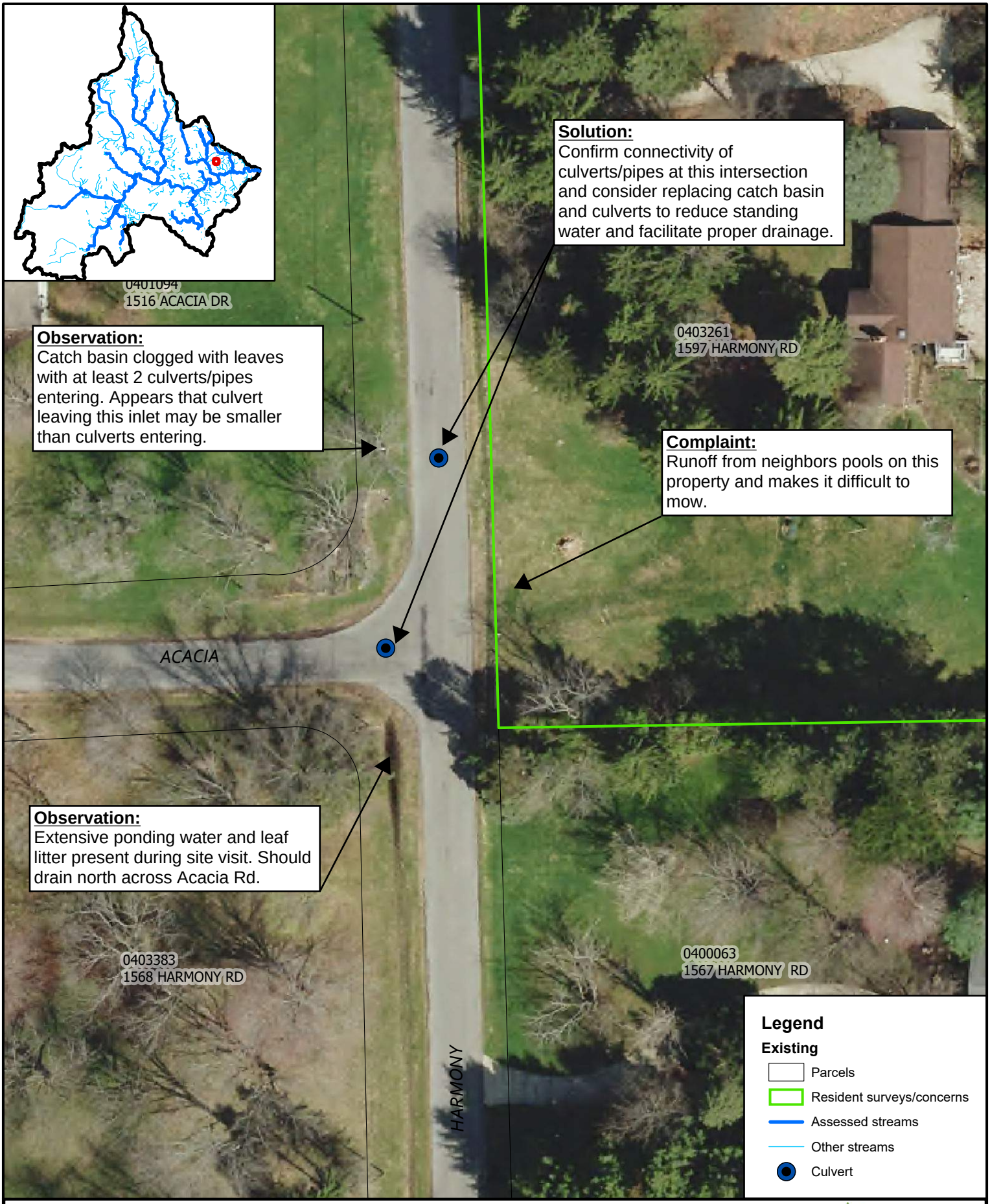
INFRASTRUCTURE IMPROVEMENT

1395 PARTRIDGE CULVERT STUDY & UPSIZING

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



N

0 20 40 Feet

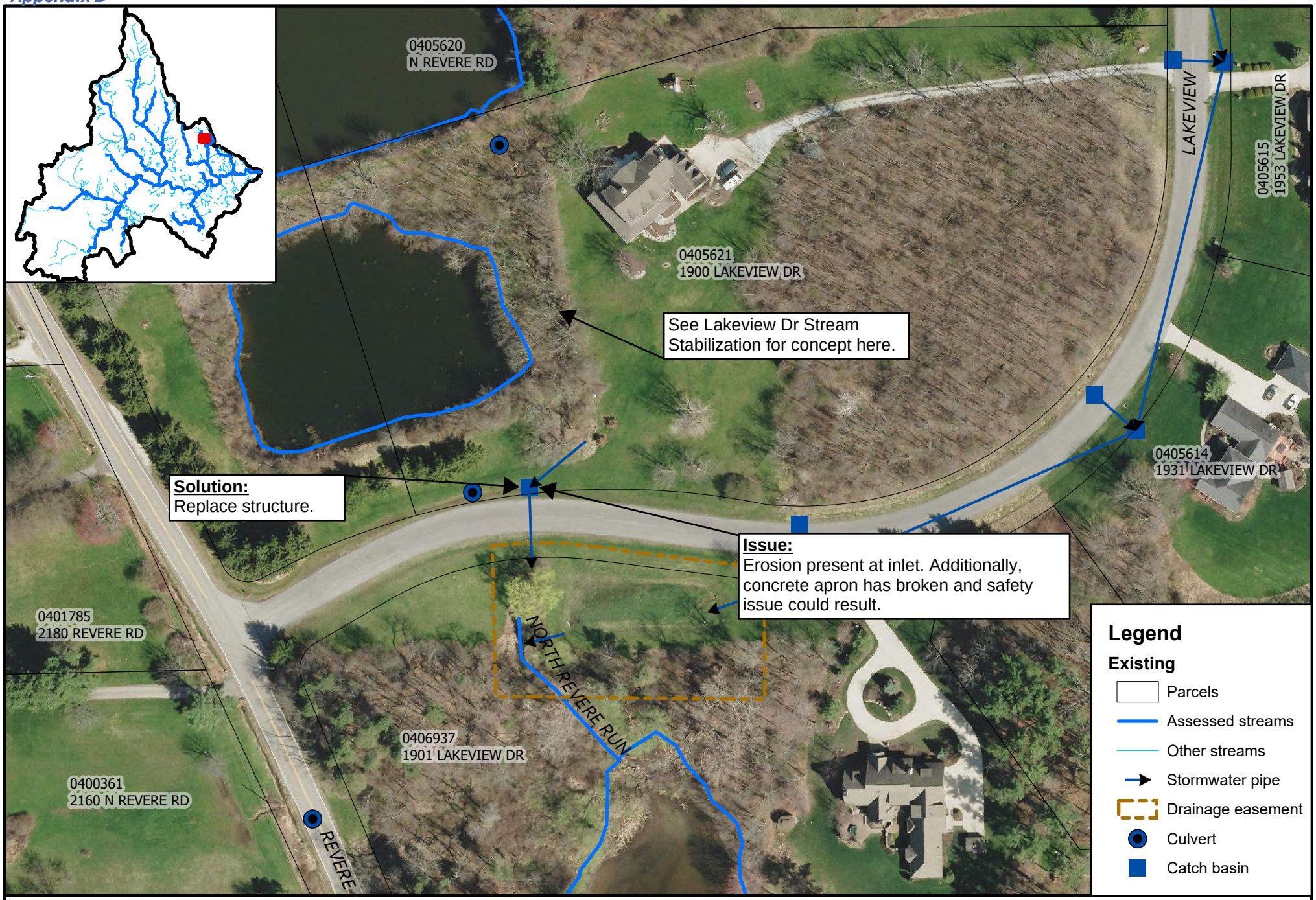
INFRASTRUCTURE IMPROVEMENT

HARMONY RD AND ACACIA DR STORM IMPROVEMENTS

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



INFRASTRUCTURE IMPROVEMENT

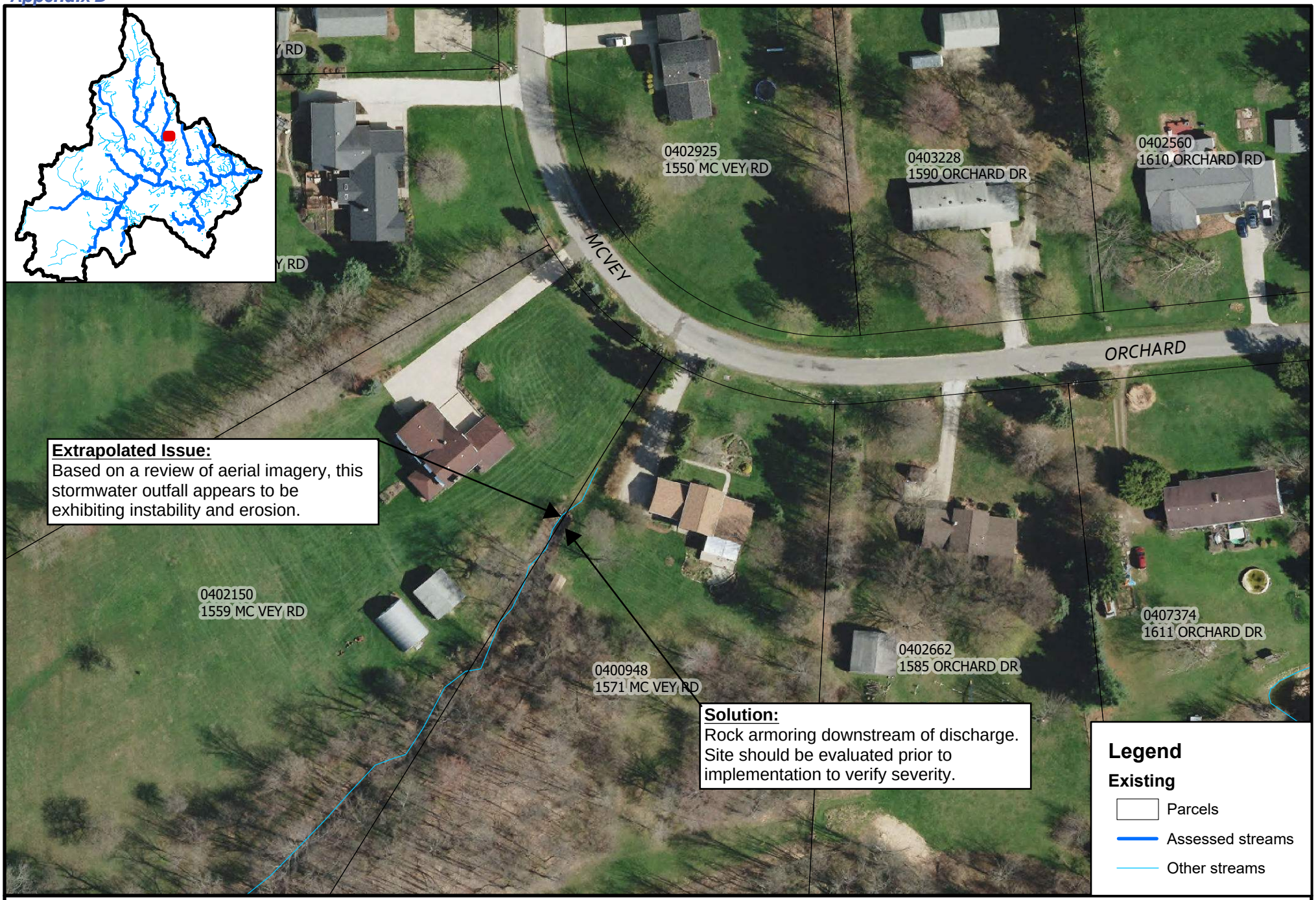
LAKEVIEW DR CATCH BASIN MAINTENANCE

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



INFRASTRUCTURE IMPROVEMENT

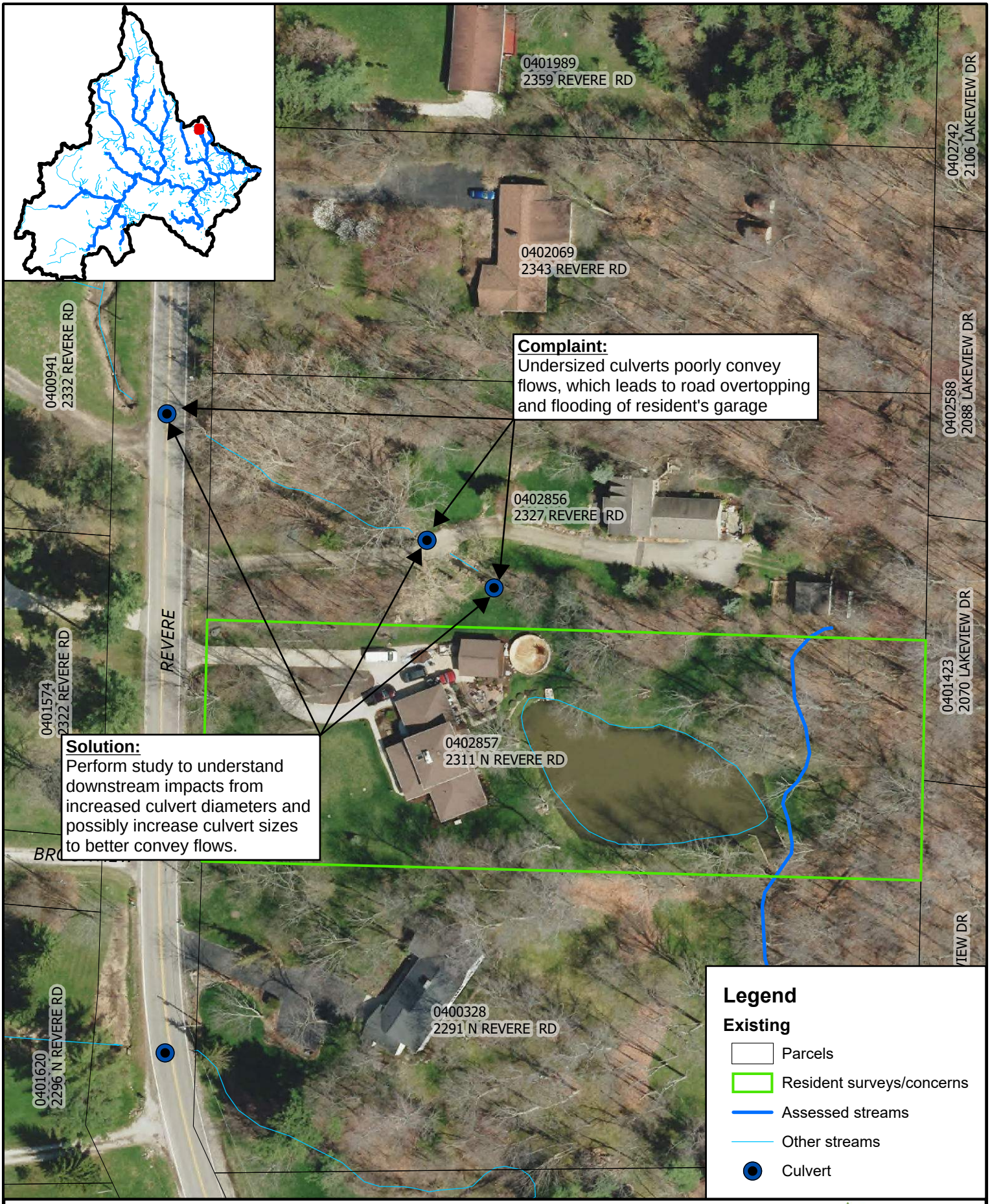
MCVEY RD OUTFALL STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



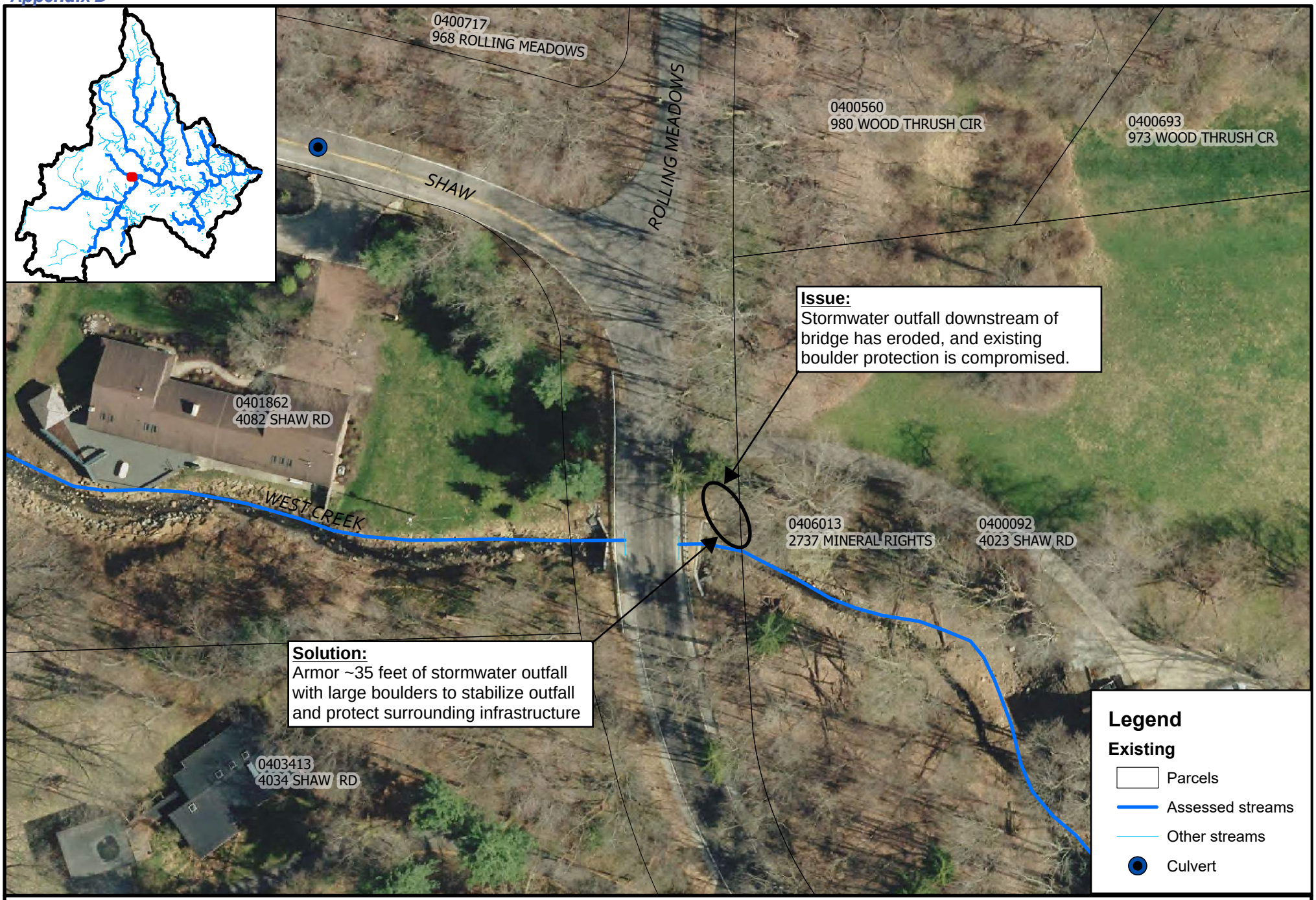
INFRASTRUCTURE IMPROVEMENT

REVERE RD 3 CULVERT STUDY & UPSIZING

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



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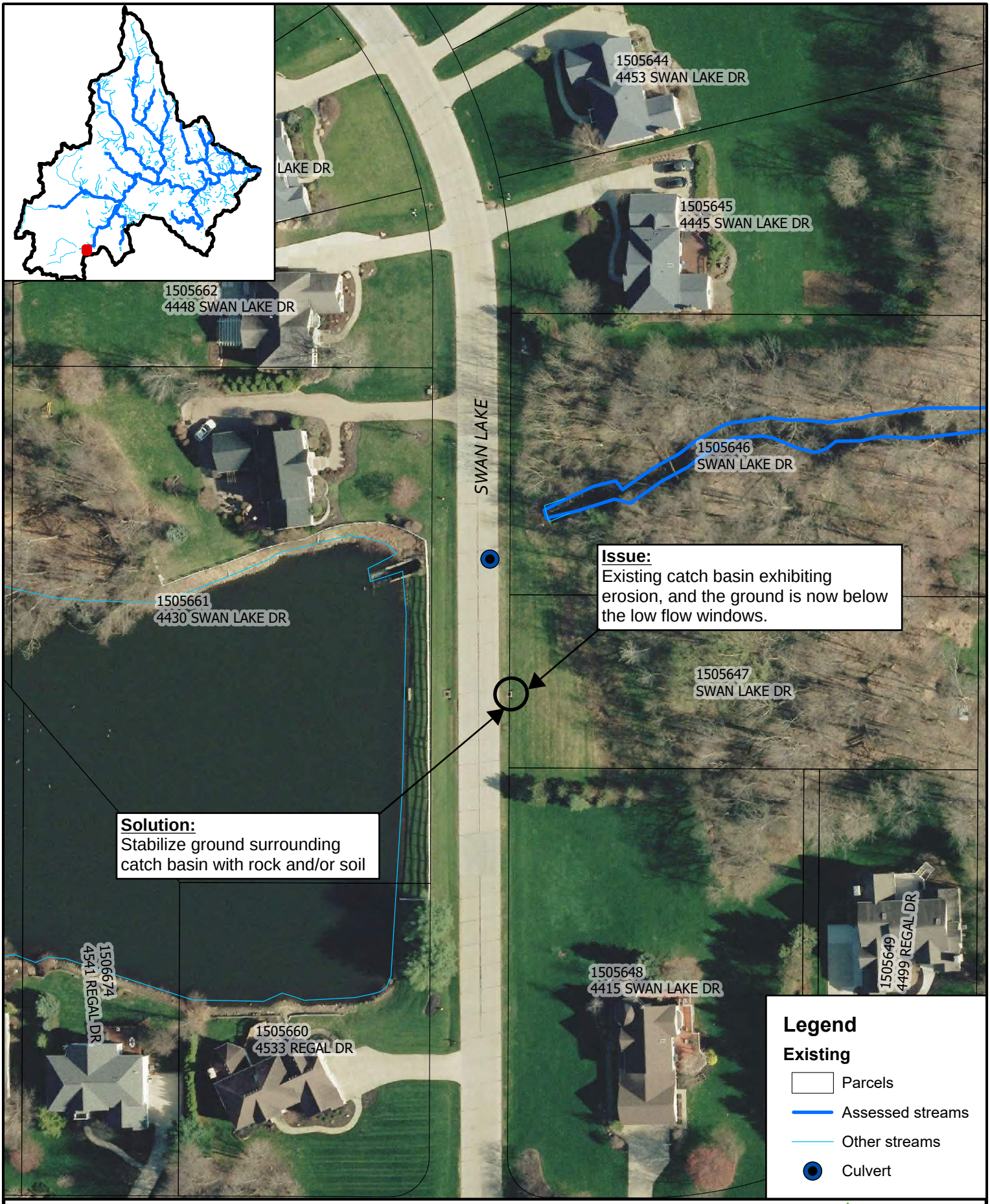
INFRASTRUCTURE IMPROVEMENT

SHAW RD OUTFALL REPAIR

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



N

0 40 80 Feet

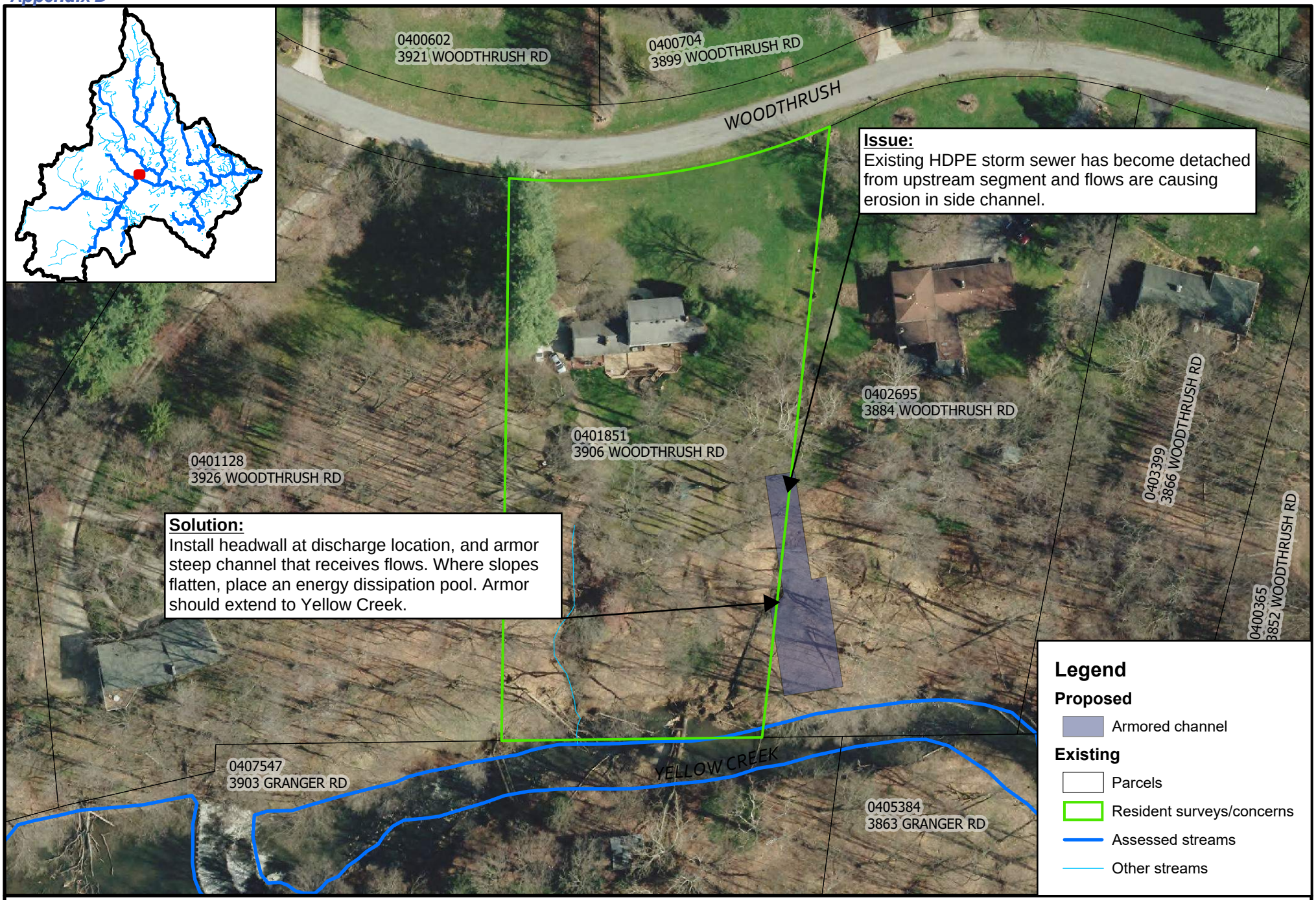
INFRASTRUCTURE IMPROVEMENT

SWAN LAKE CATCH BASIN MAINTENANCE

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



INFRASTRUCTURE IMPROVEMENT

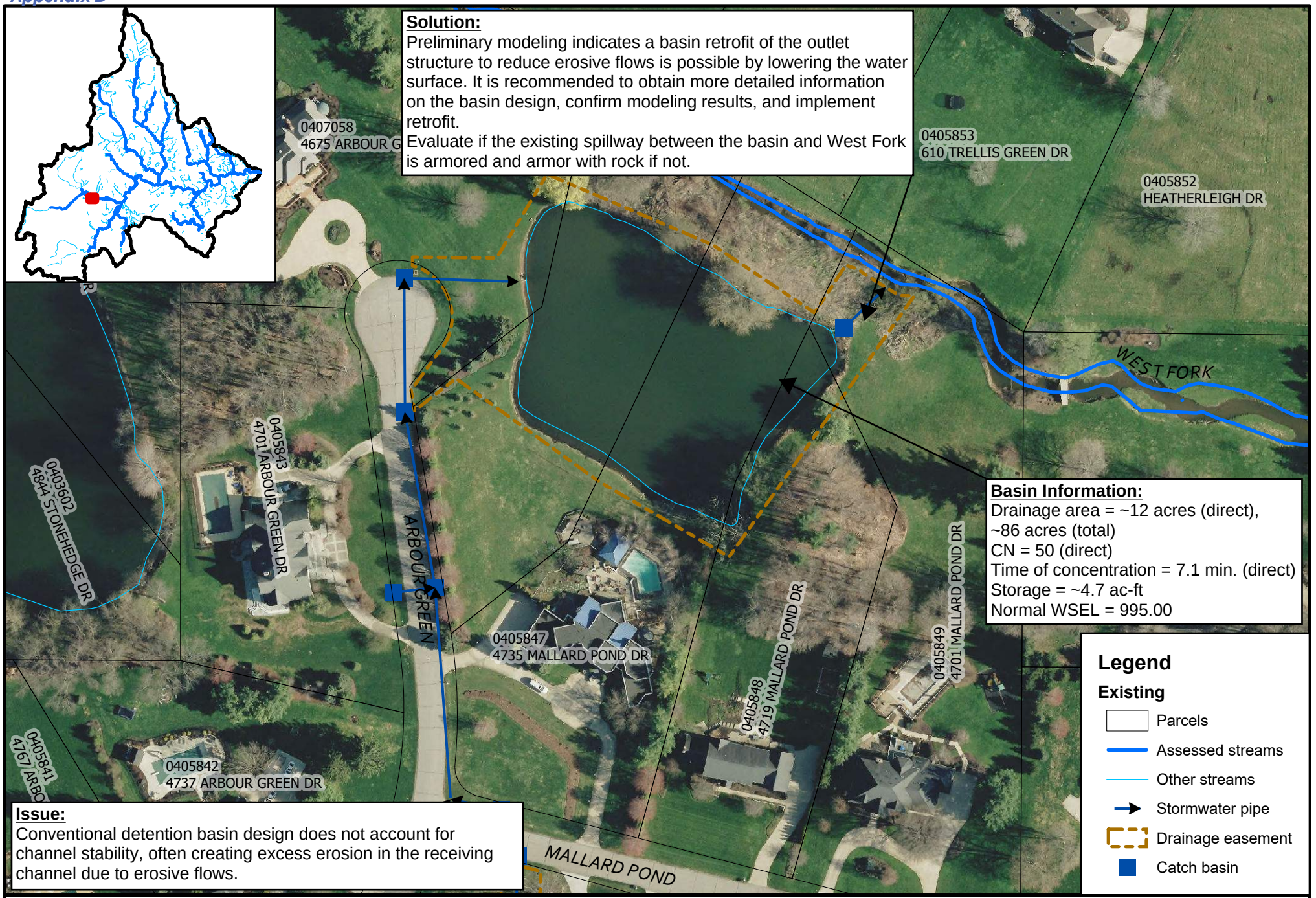
WOODTHRUSH STORM SEWER REPAIR AND CHANNEL STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Friday, July 5, 2019



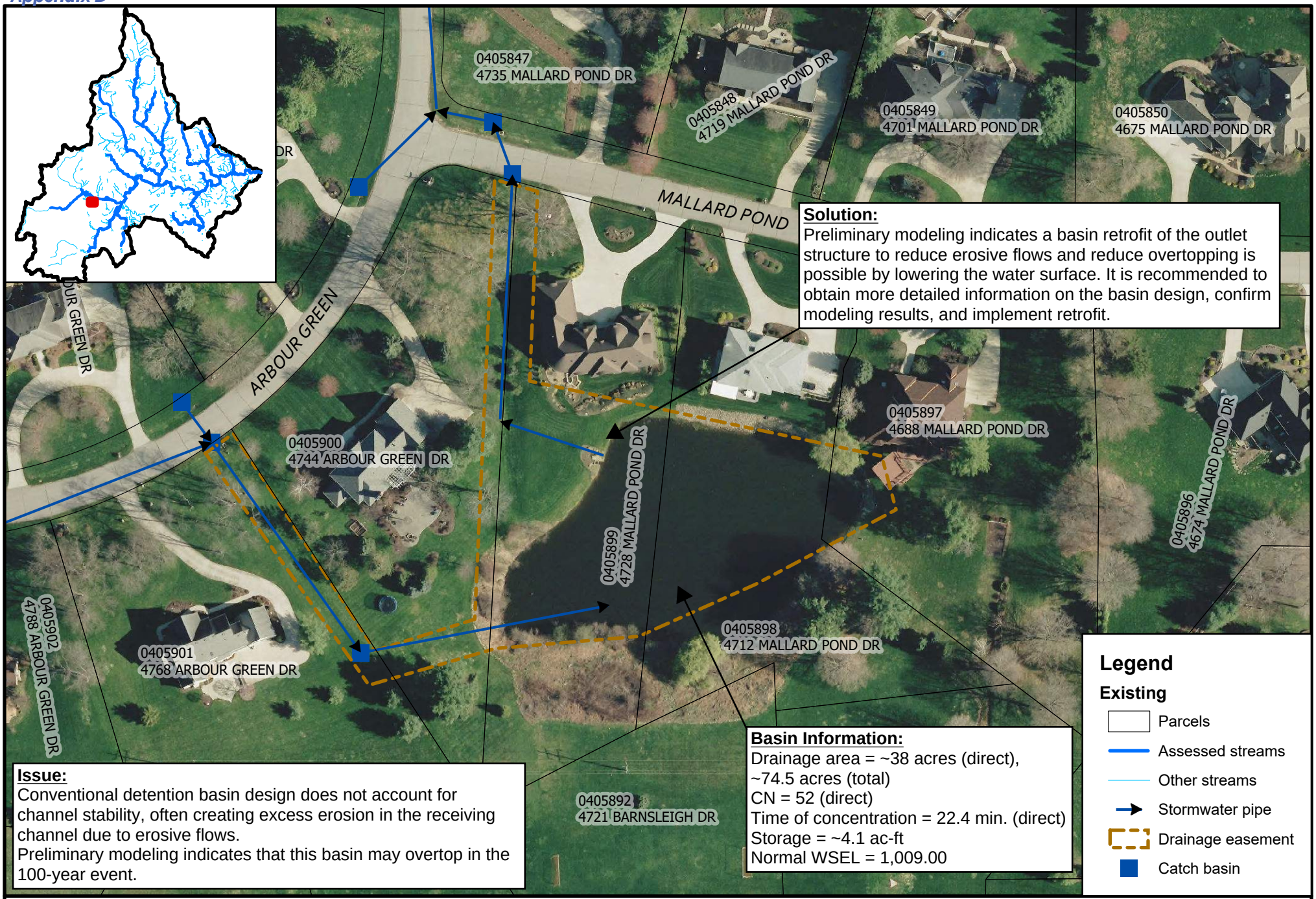
STORMWATER CONTROL MEASURE OPTIMIZATION

ARBOUR GREEN NORTH SPILLWAY AND RETROFIT EVALUATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



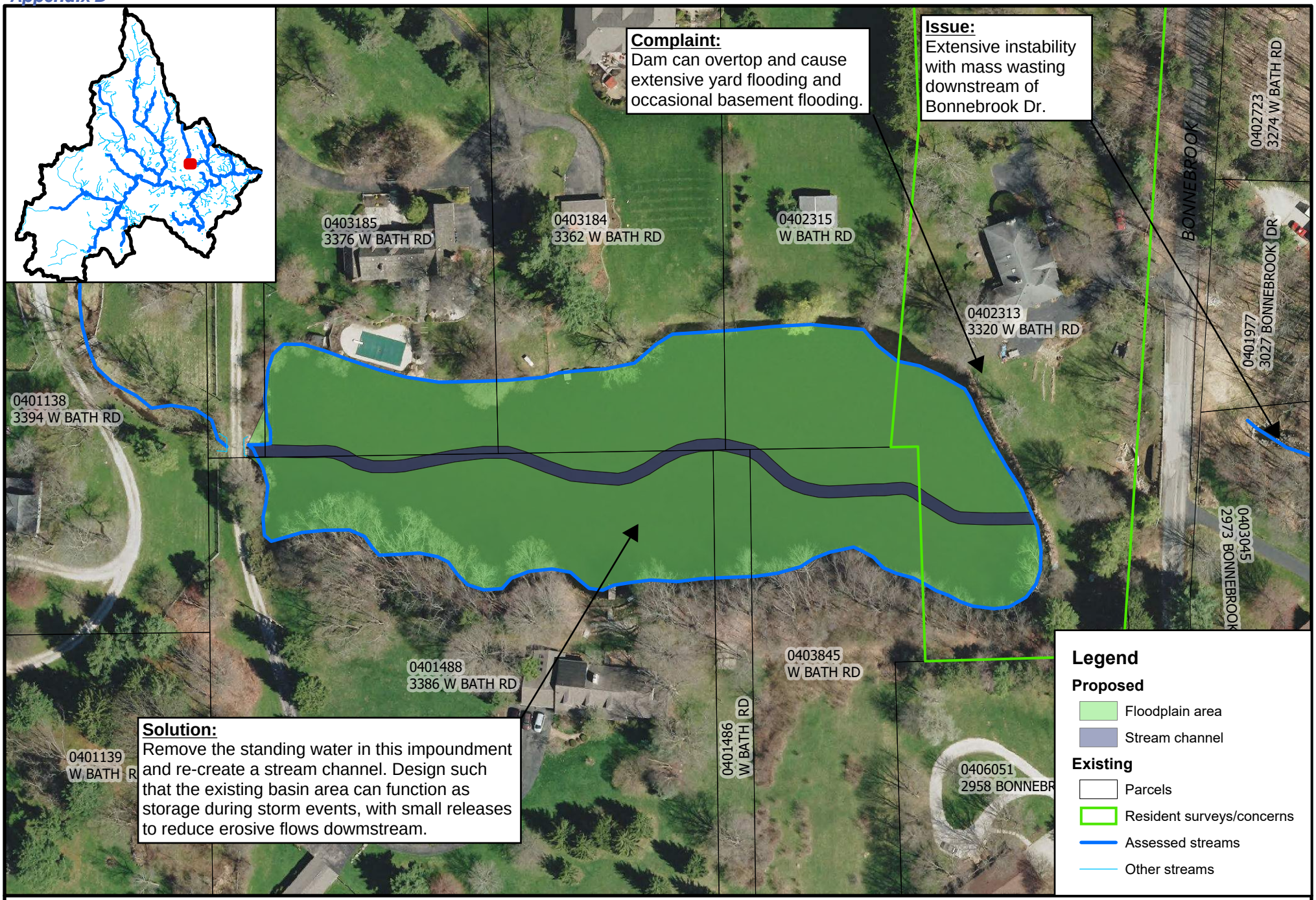
STORMWATER CONTROL MEASURE OPTIMIZATION

ARBOUR GREEN SOUTH FLOODING RISK EVALUATION AND RETROFIT

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



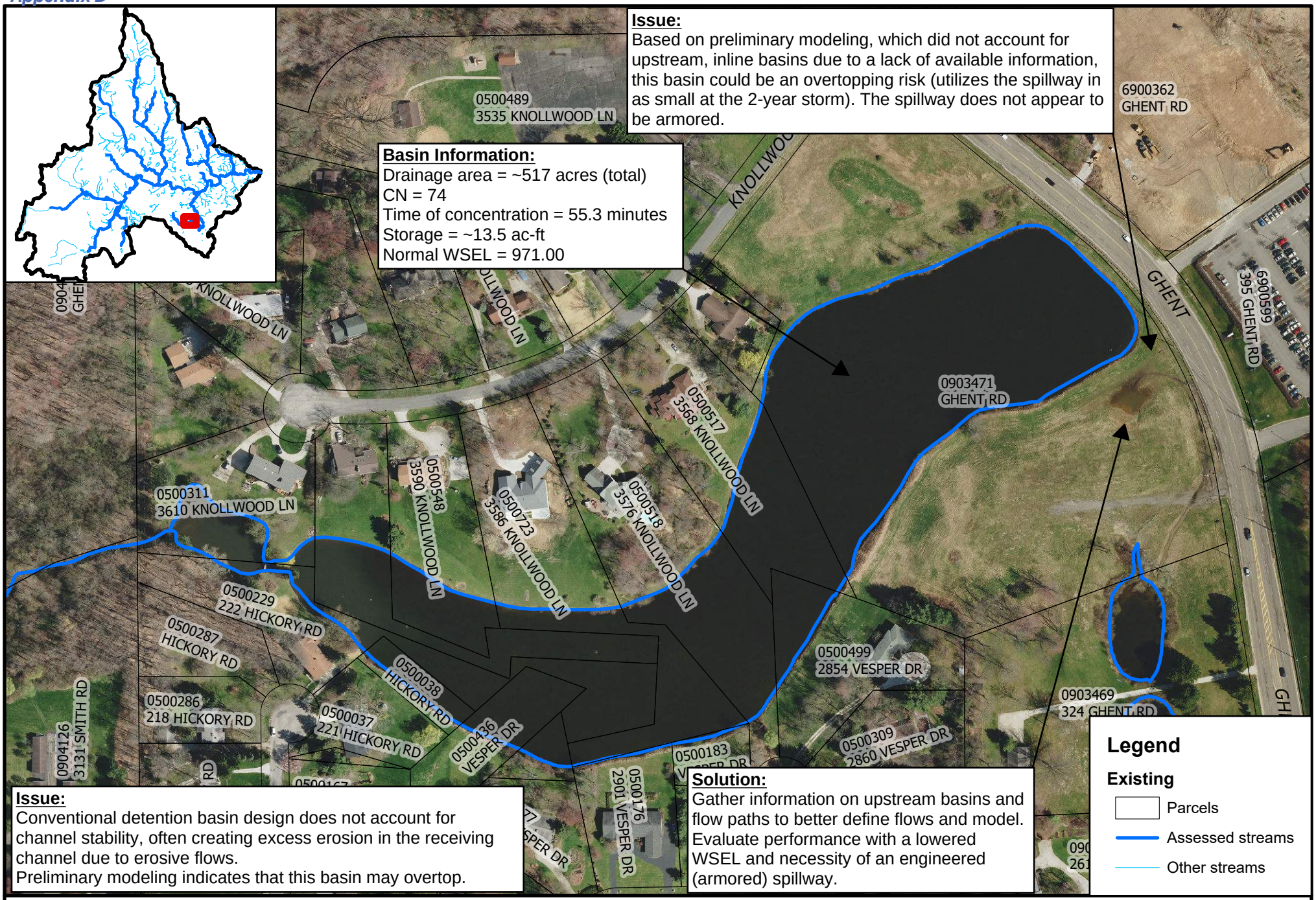
STORMWATER CONTROL MEASURE OPTIMIZATION

BONNEBROOK DR STREAM/WETLAND COMPLEX WITH WET WEATHER DETENTION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



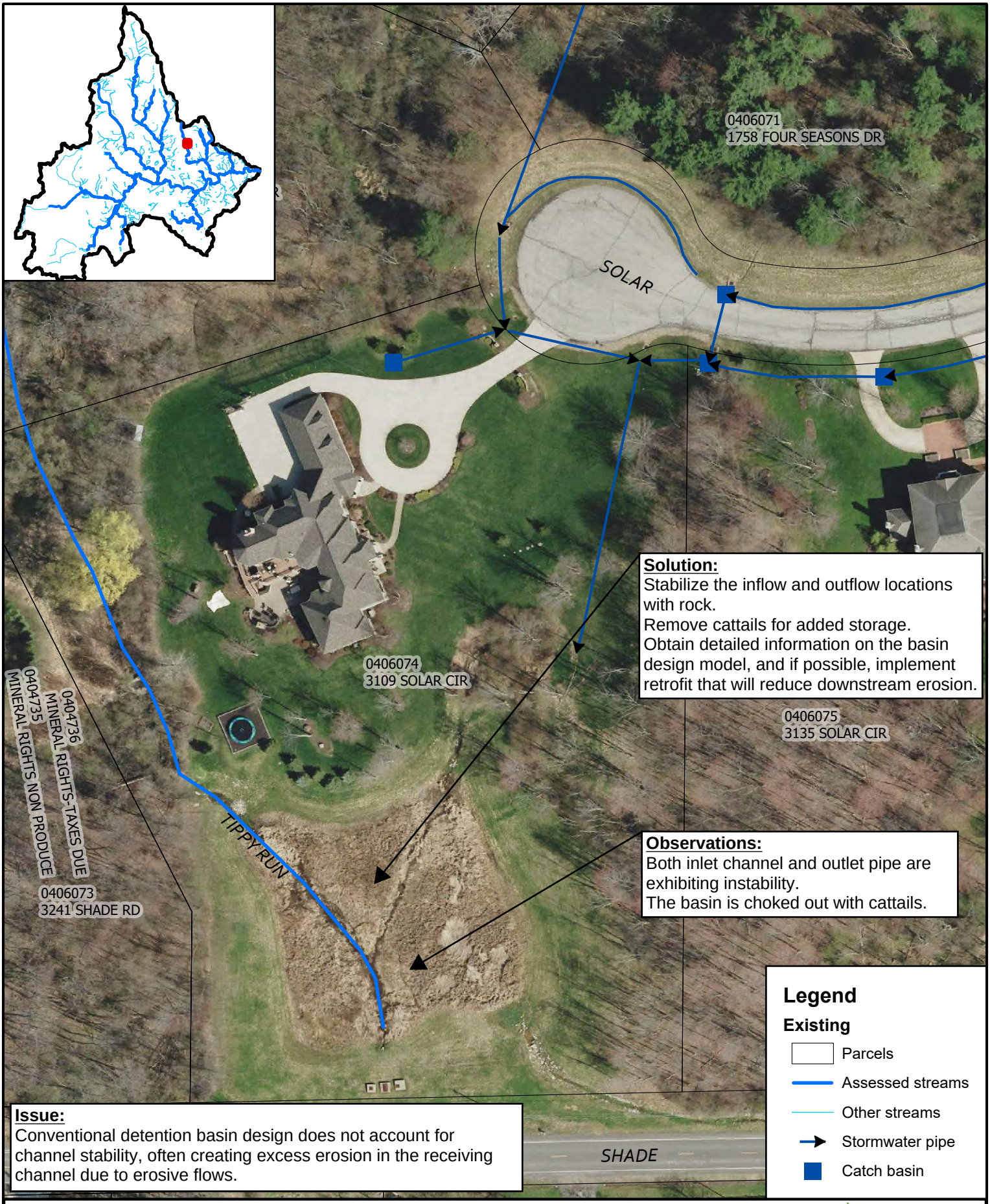
STORMWATER CONTROL MEASURE OPTIMIZATION

GHENT ROAD BASIN SPILLWAY EVALUATION AND ENHANCEMENT

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



N

0 50 100 Feet

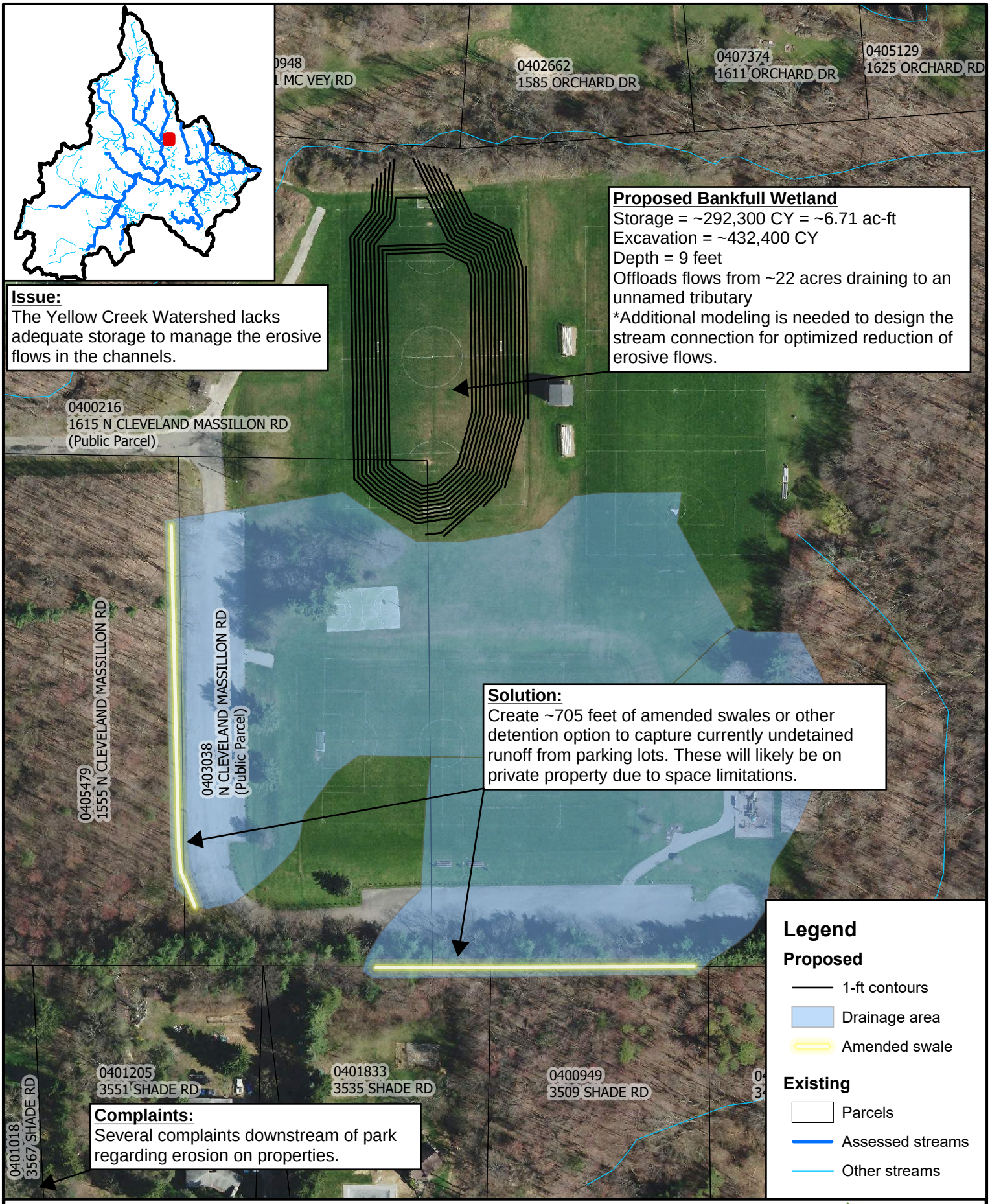
STORMWATER CONTROL MEASURE OPTIMIZATION

SOLAR CIR BASIN RETROFIT

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



N

0 50 100 Feet

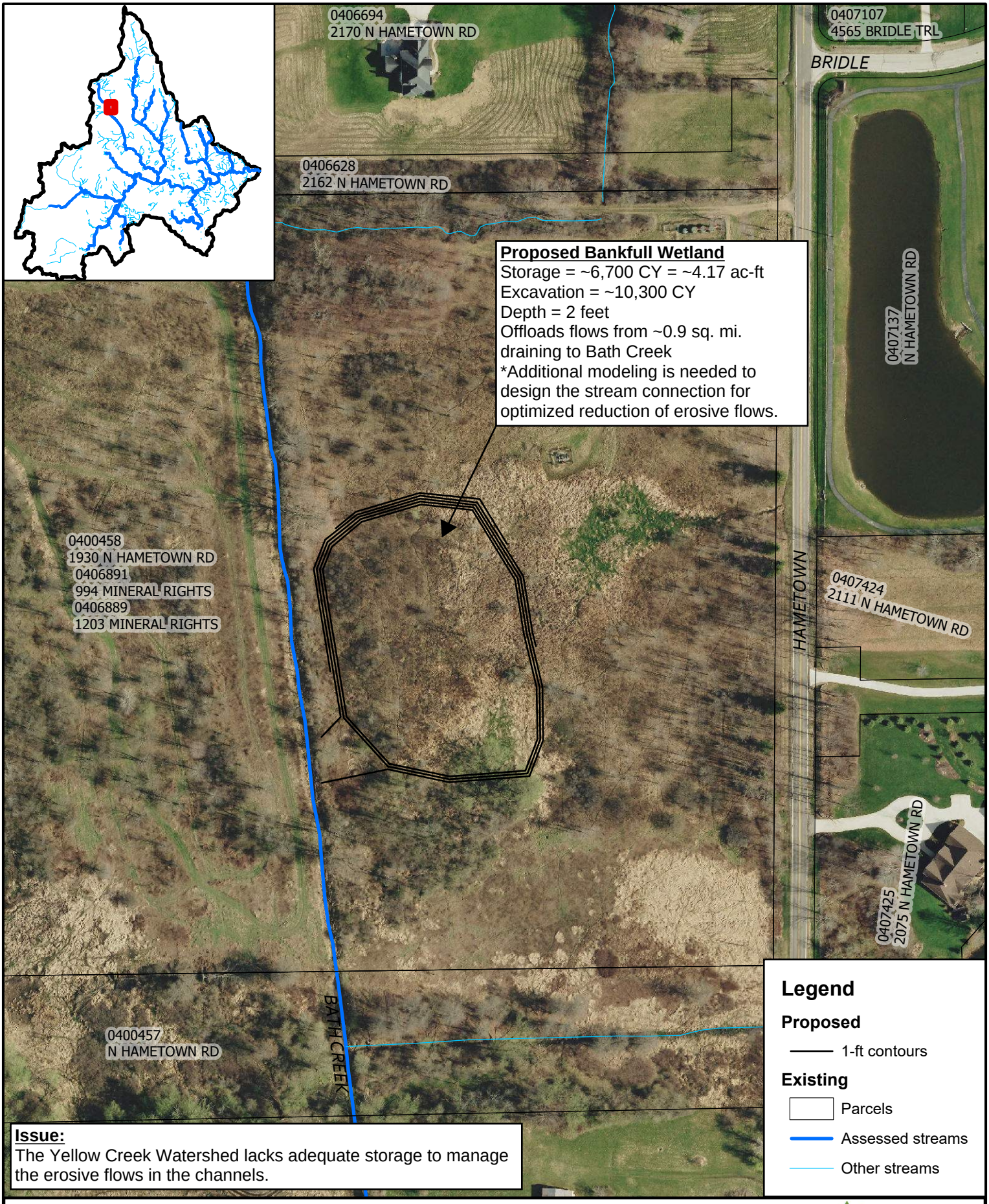
NEW STORMWATER CONTROL MEASURE

BATH COMMUNITY PARK BANKFULL WETLAND AND DETENTION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



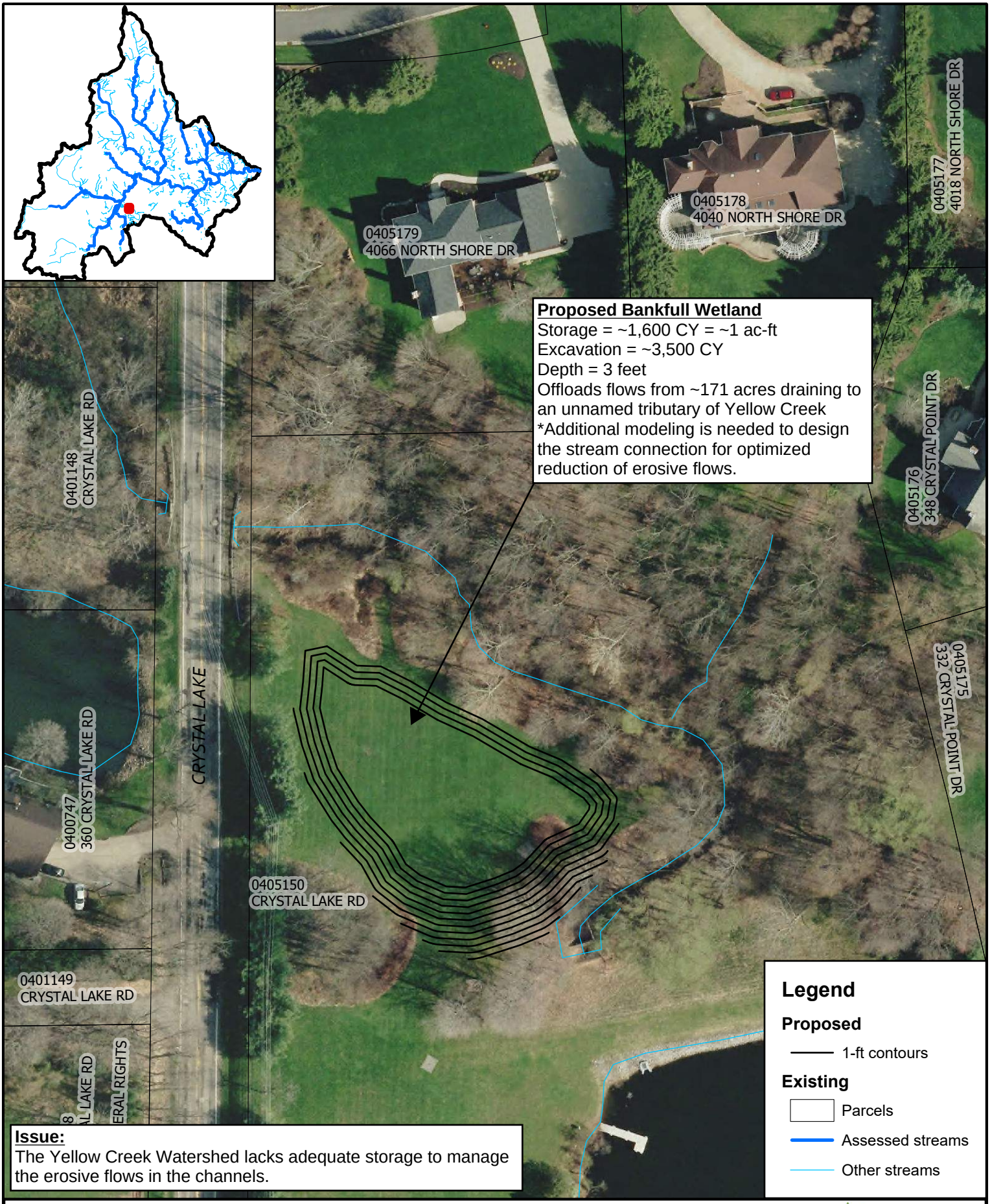
NEW STORMWATER CONTROL MEASURE

CAMP CHRISTOPHER BANKFULL WETLAND

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

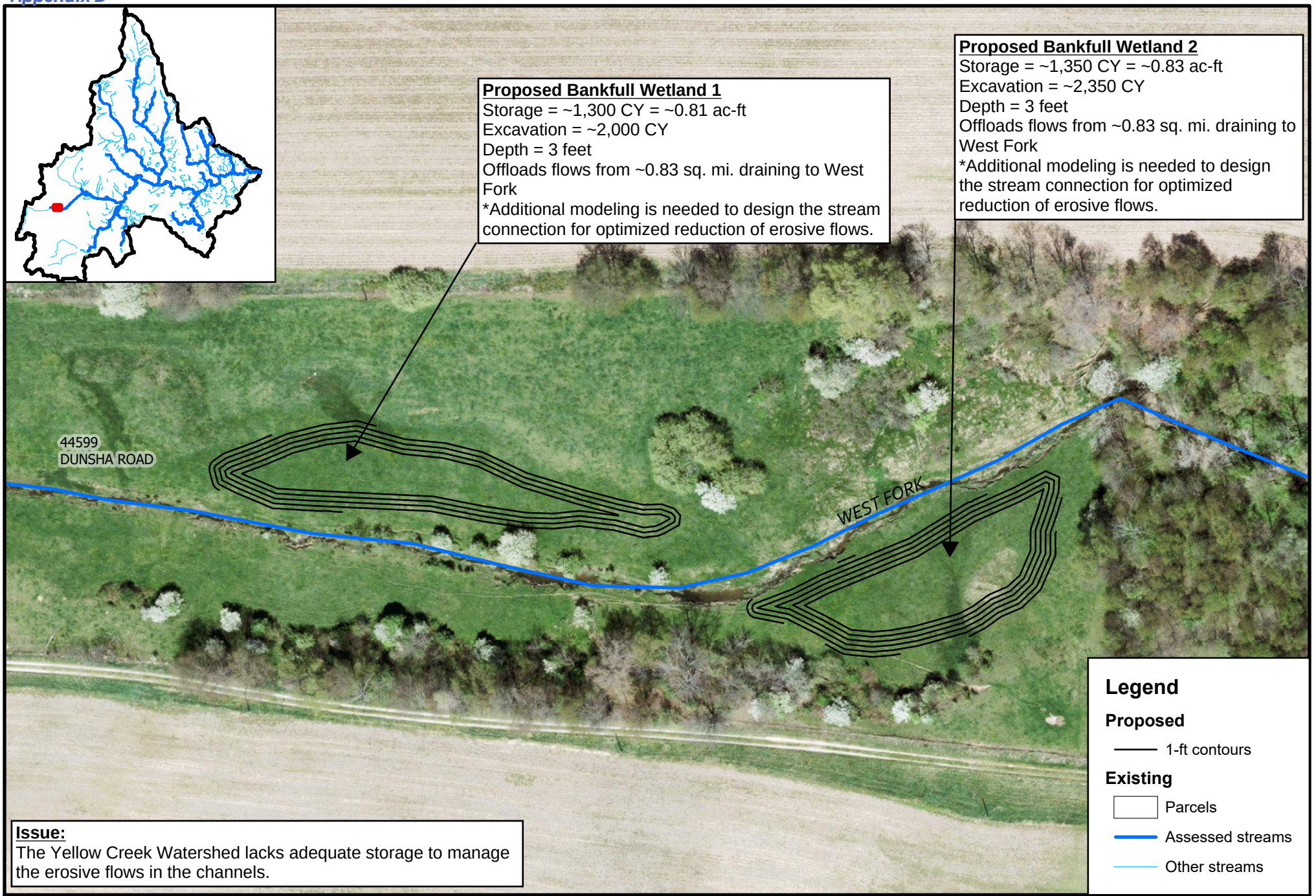
SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



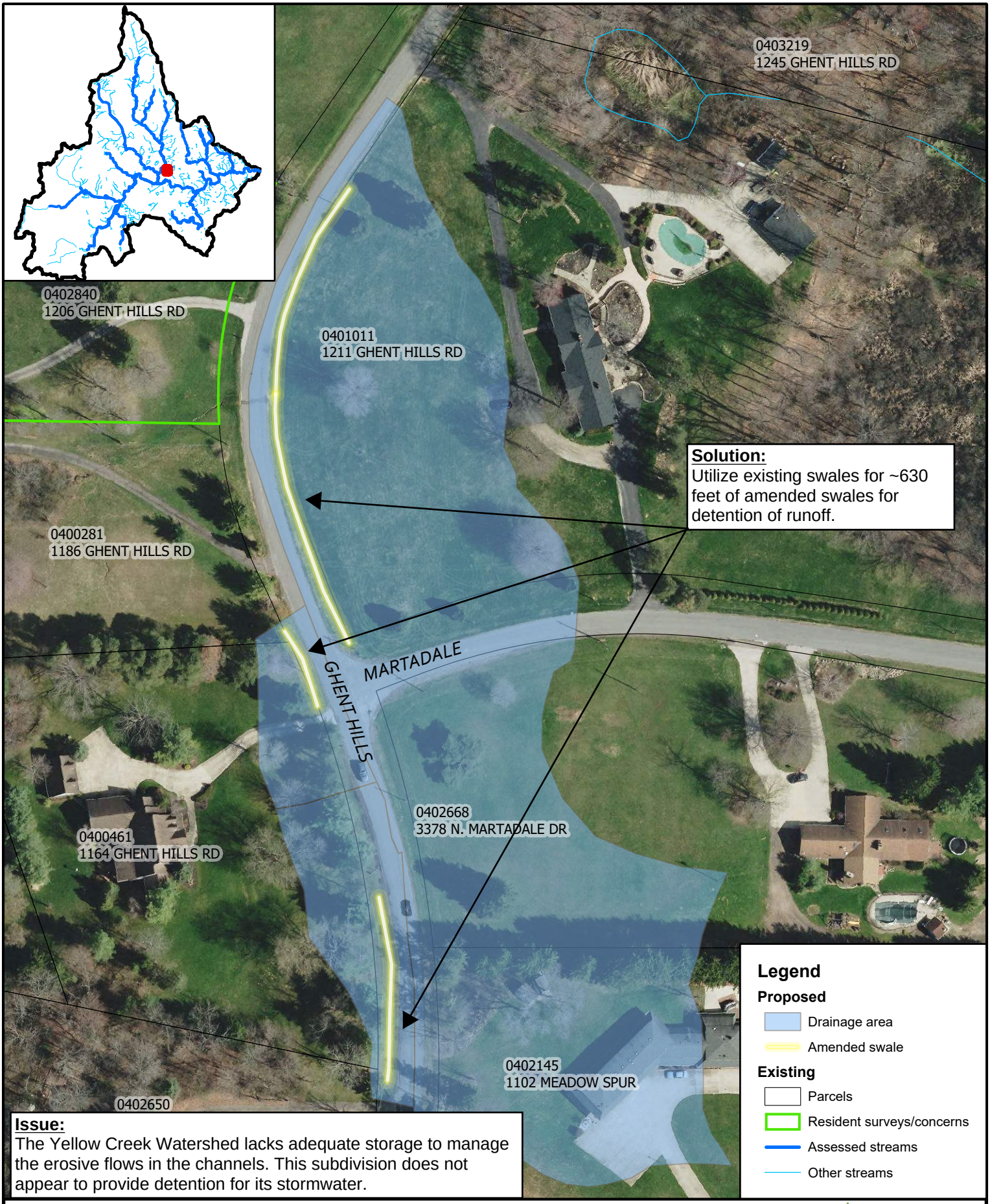
NEW STORMWATER CONTROL MEASURE
CRYSTAL SHORES BANKFULL WETLAND
BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT
SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



NEW STORMWATER CONTROL MEASURE
DUNSHA BANKFULL WETLANDS 1 & 2
BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT
SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



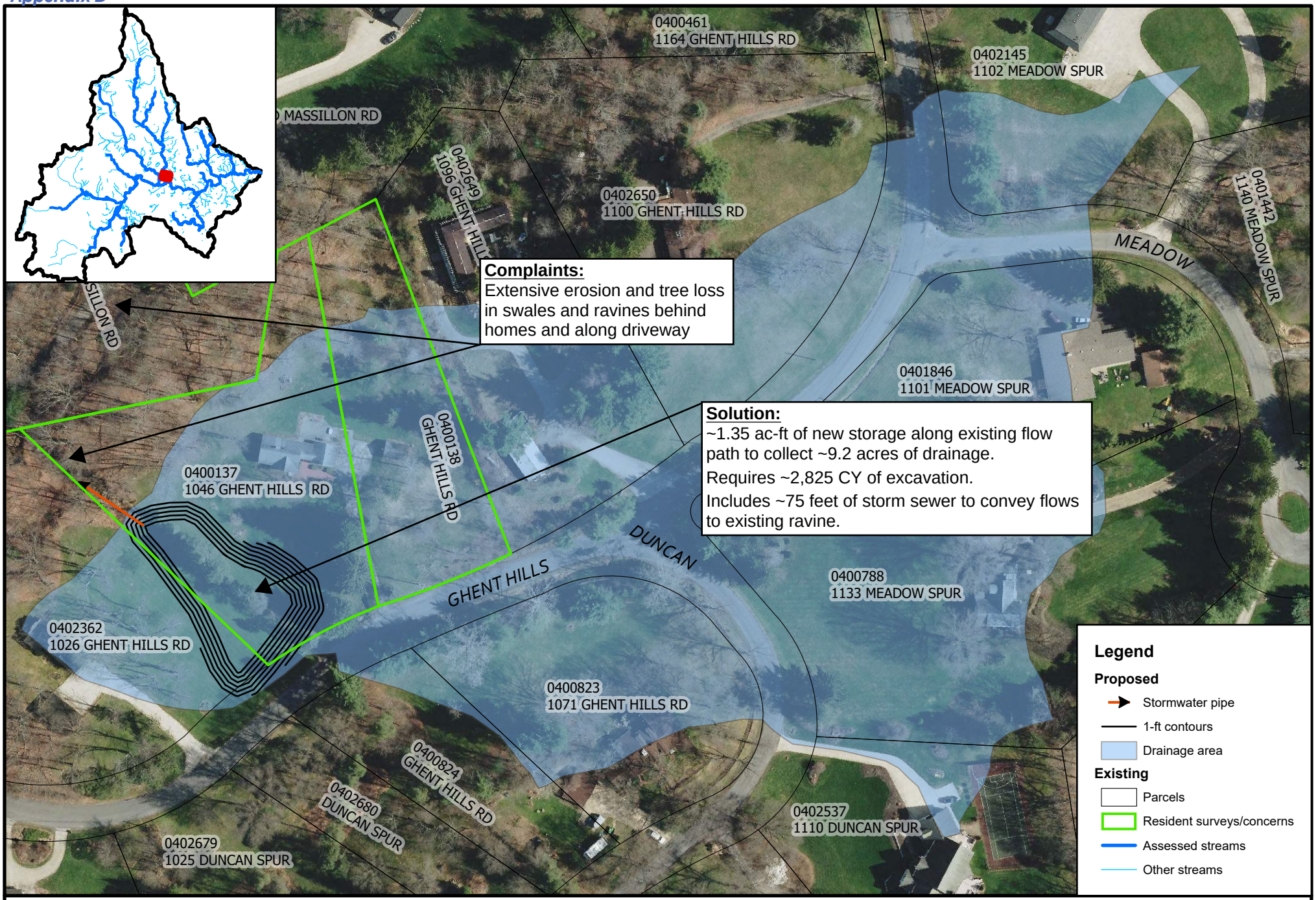
NEW STORMWATER CONTROL MEASURE

GHENT HILLS AMENDED SWALES

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



NEW STORMWATER CONTROL MEASURE

GHENT HILLS DETENTION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Monday, July 8, 2019

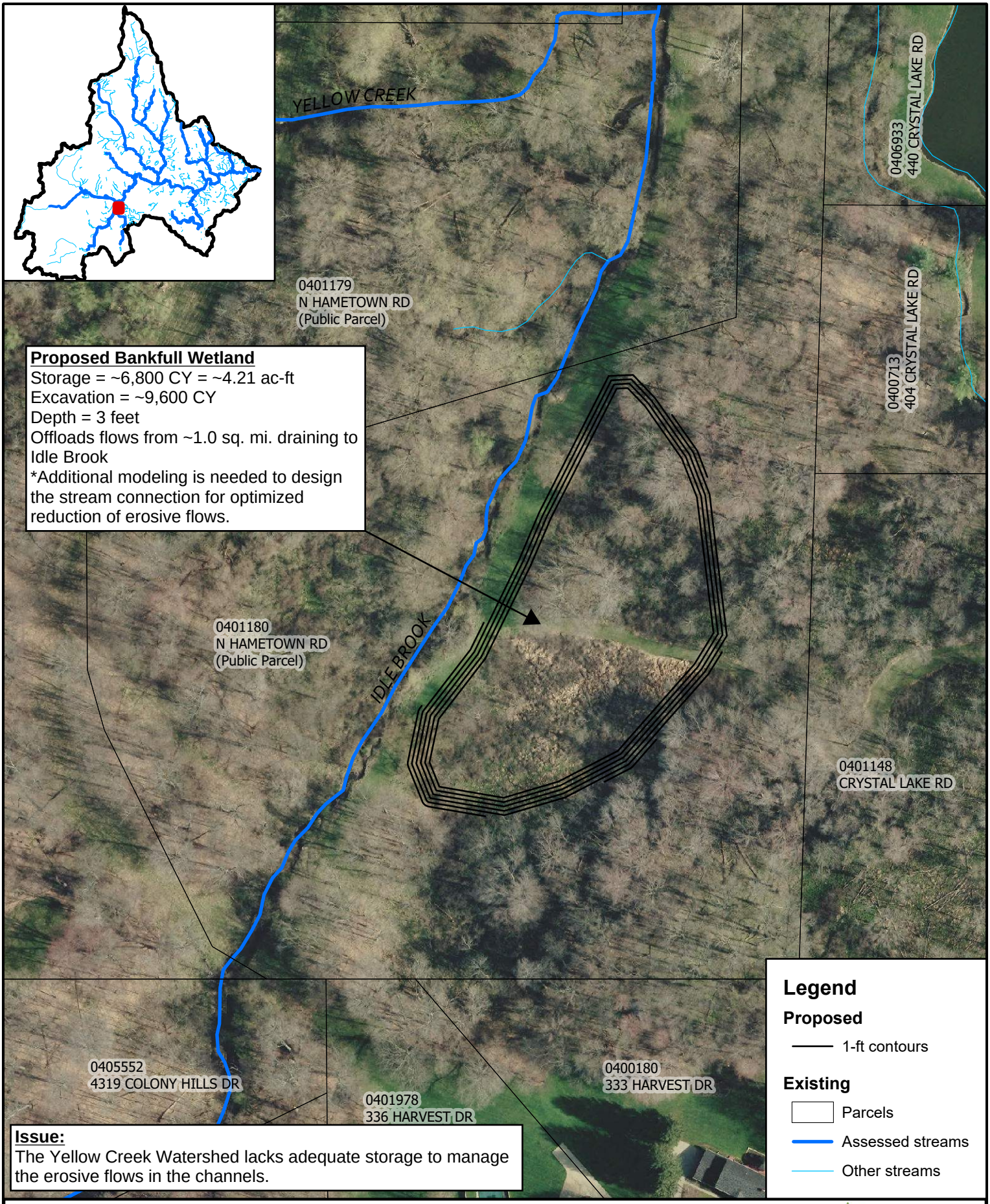
NEW STORMWATER CONTROL MEASURE

I-77 REST AREA BANKFULL WETLAND

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



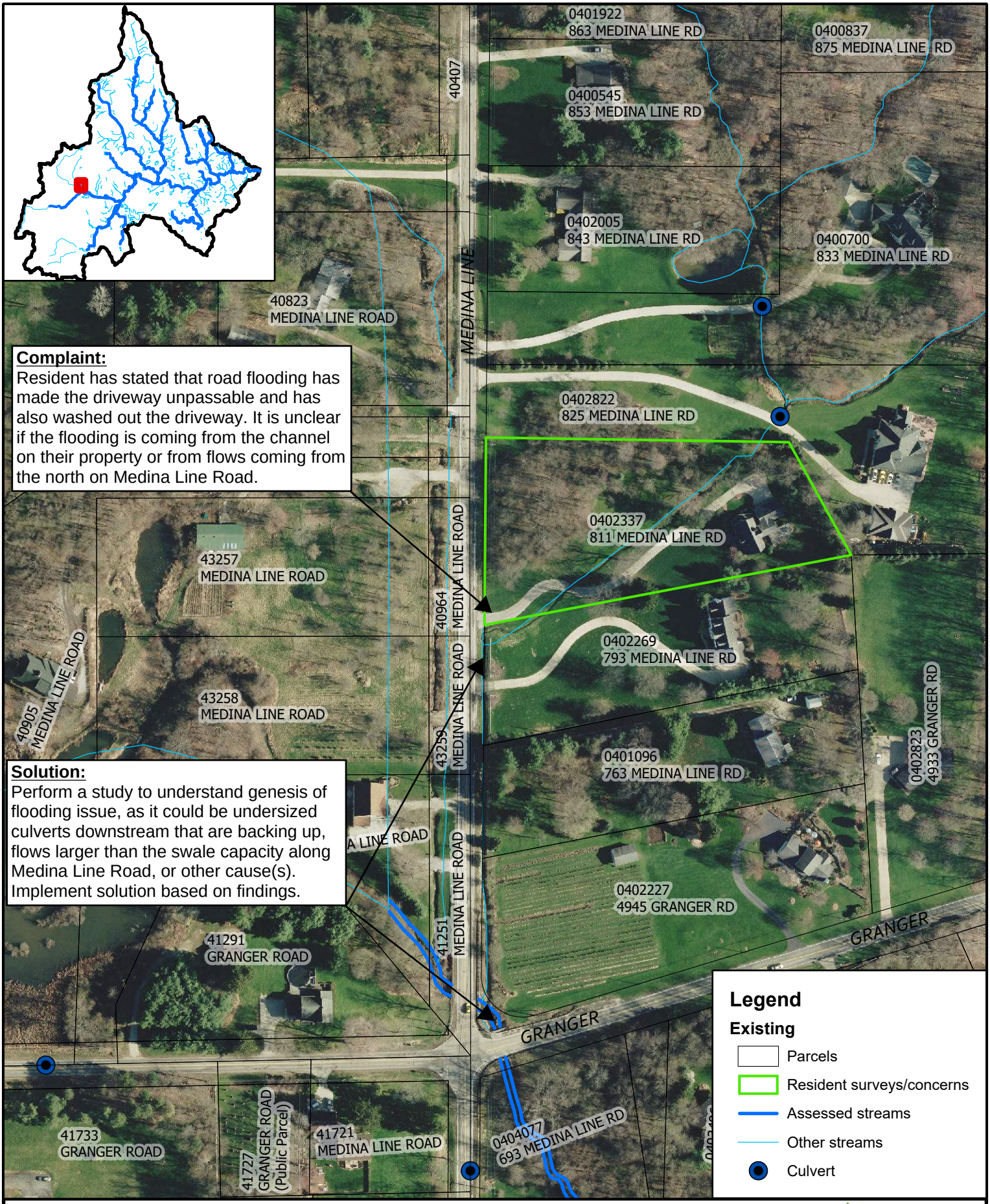
NEW STORMWATER CONTROL MEASURE

IDLE BROOK BANKFULL WETLAND

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



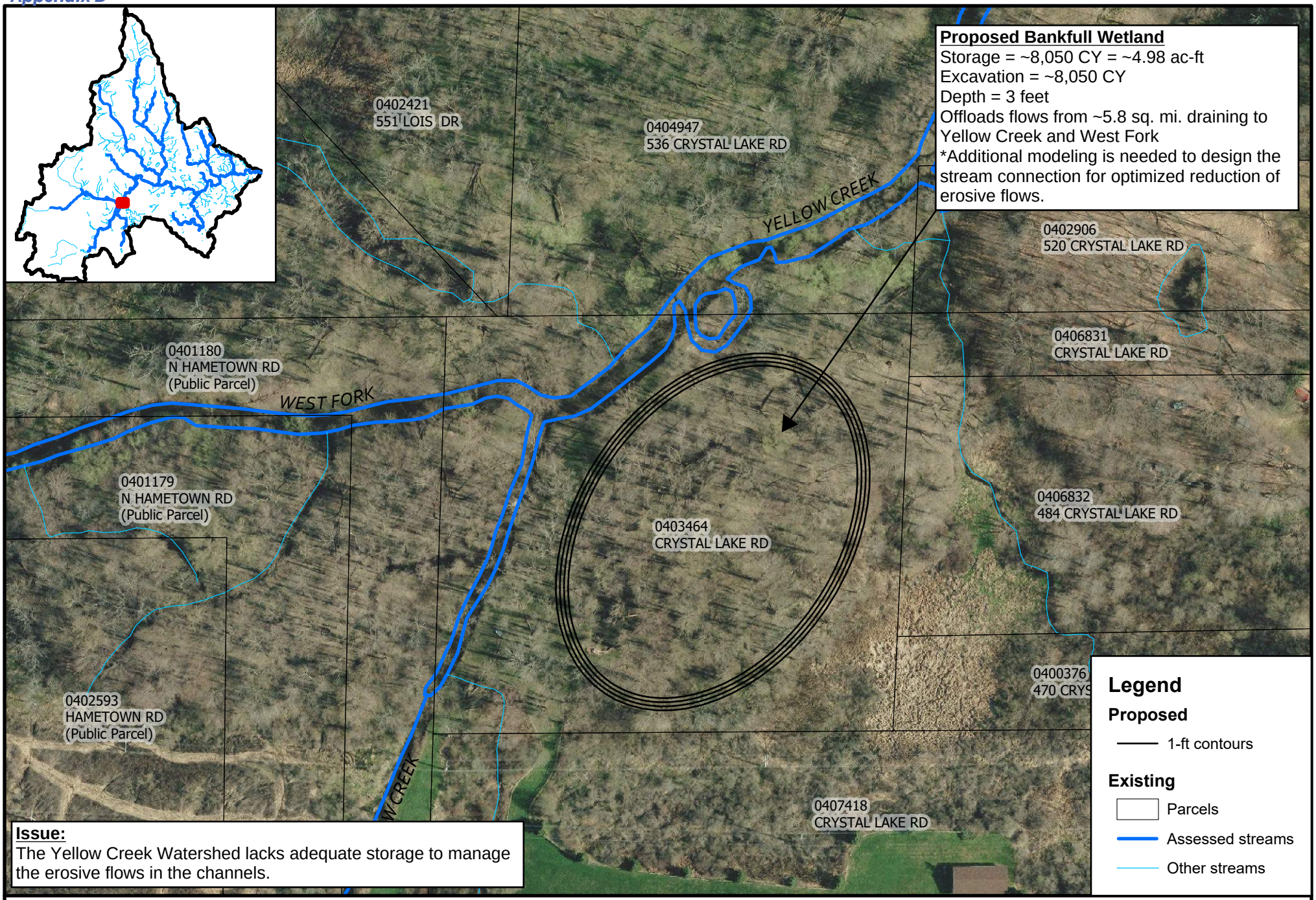
NEW STORMWATER CONTROL MEASURE

MEDINA LINE PONDED WATER STUDY AND IMPROVEMENTS

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



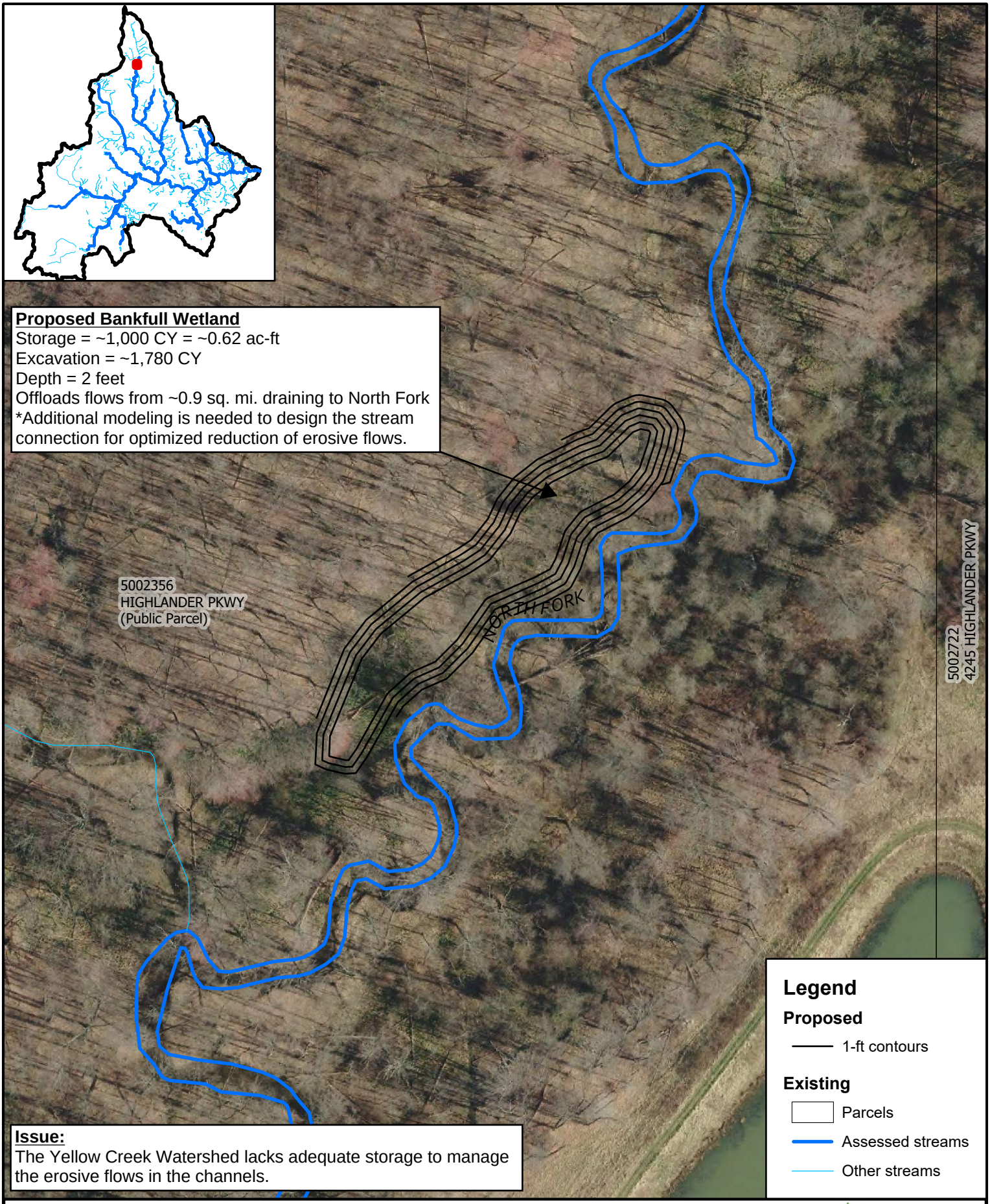
NEW STORMWATER CONTROL MEASURE

NESTER BANKFULL WETLAND

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



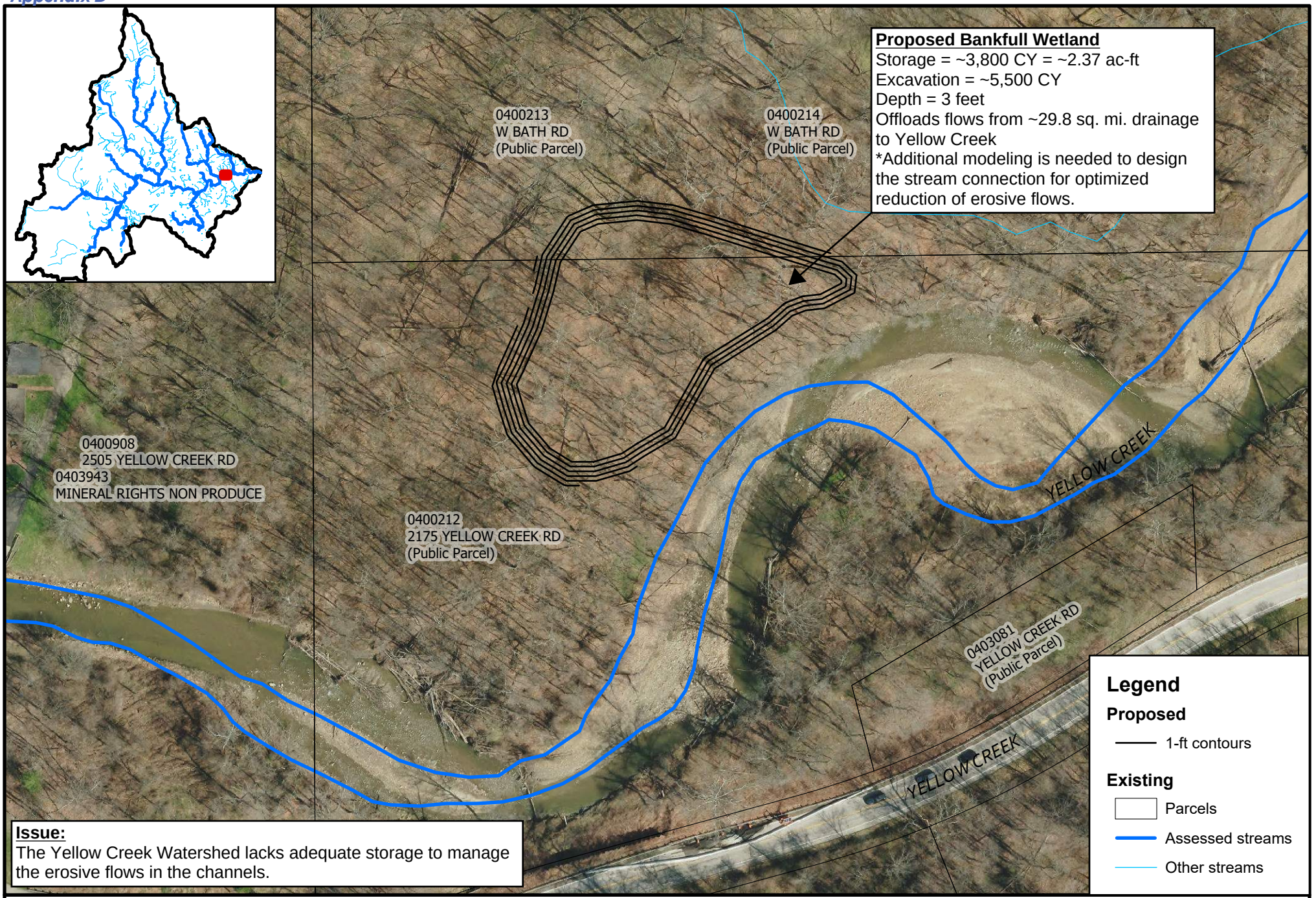
NEW STORMWATER CONTROL MEASURE

NORTH FORK BANKFULL WETLAND

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

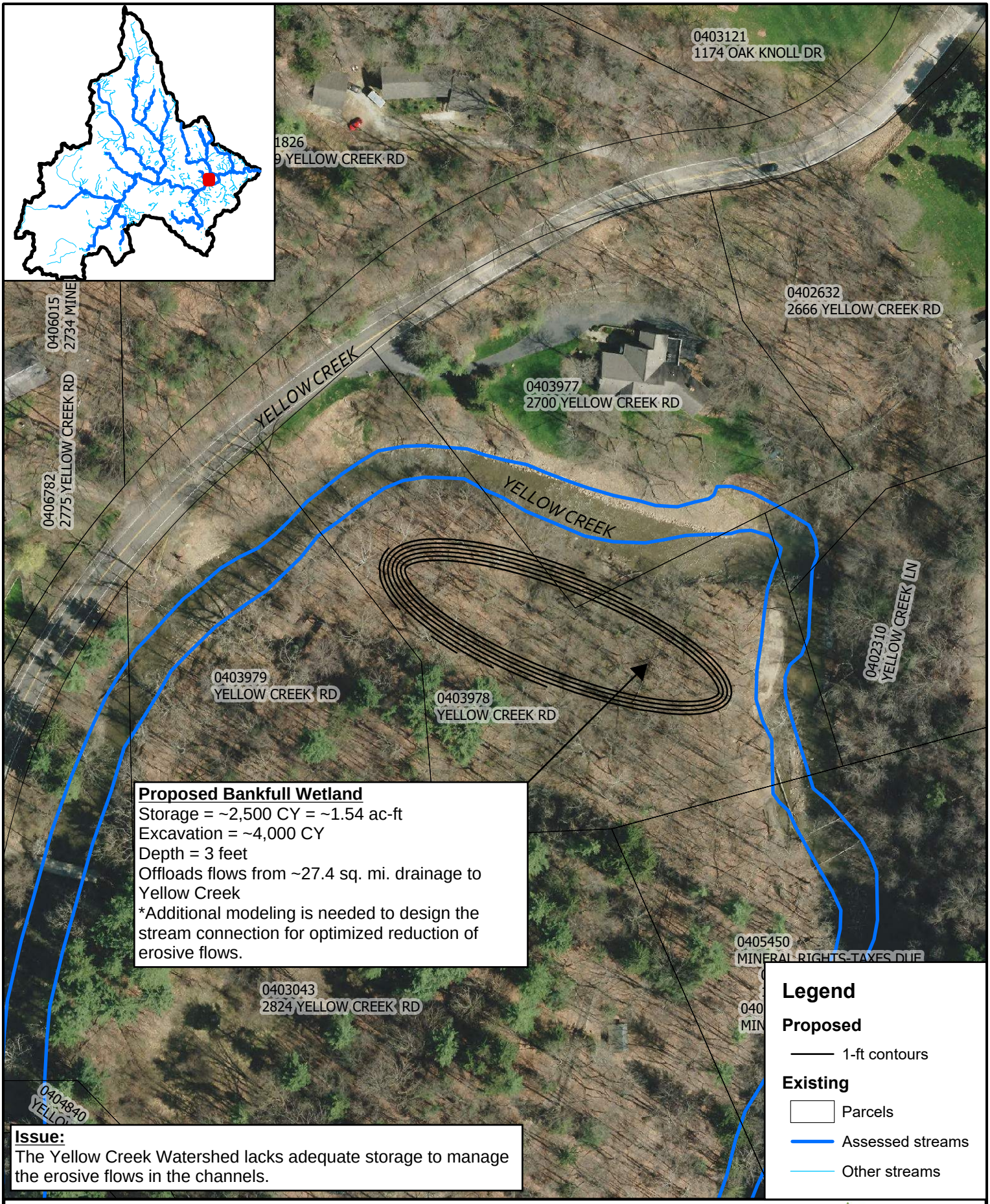
SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



NEW STORMWATER CONTROL MEASURE
O'NEILL WOODS BANKFULL WETLAND
BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT
SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



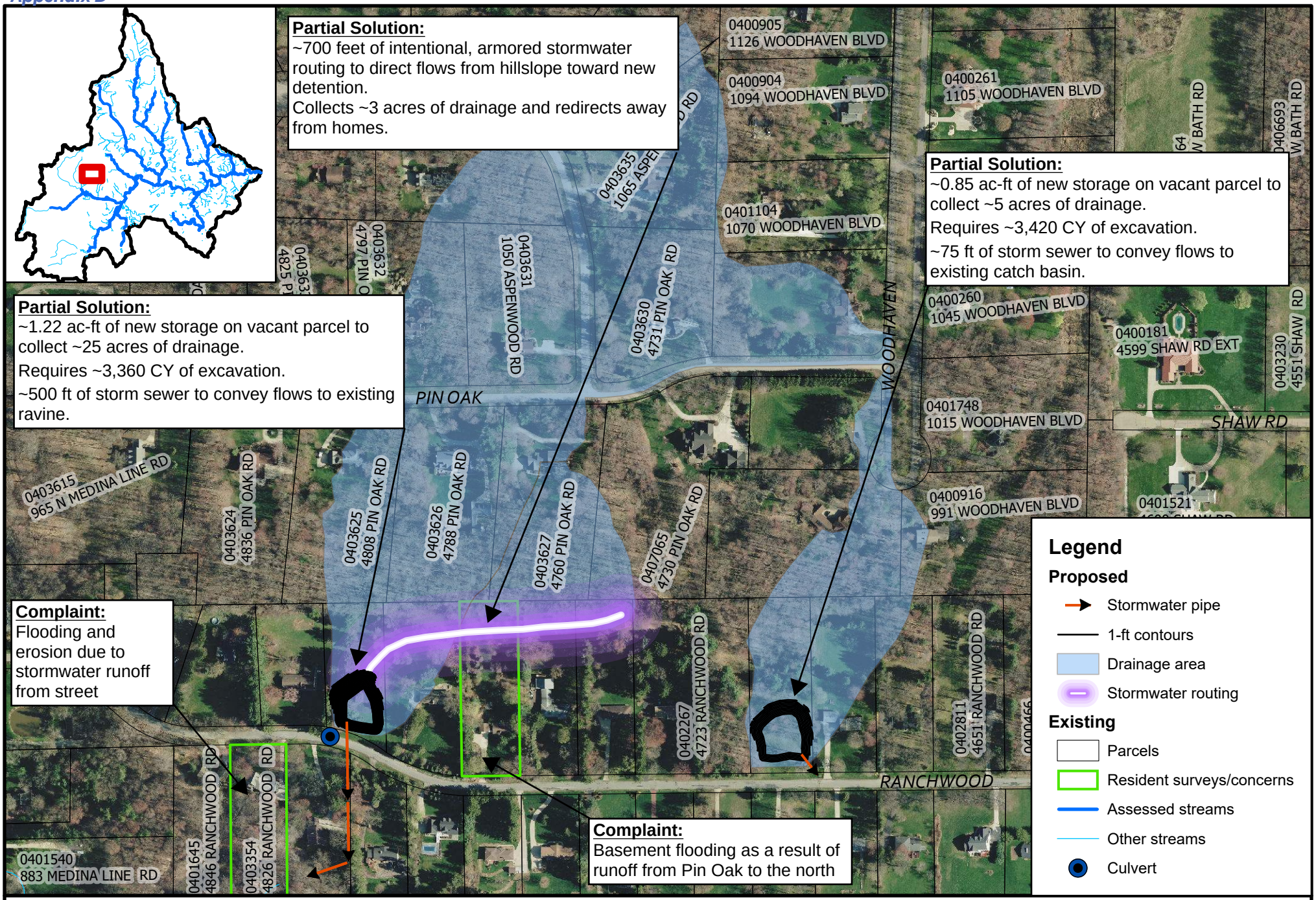
NEW STORMWATER CONTROL MEASURE

PRESTON BANKFULL WETLAND

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



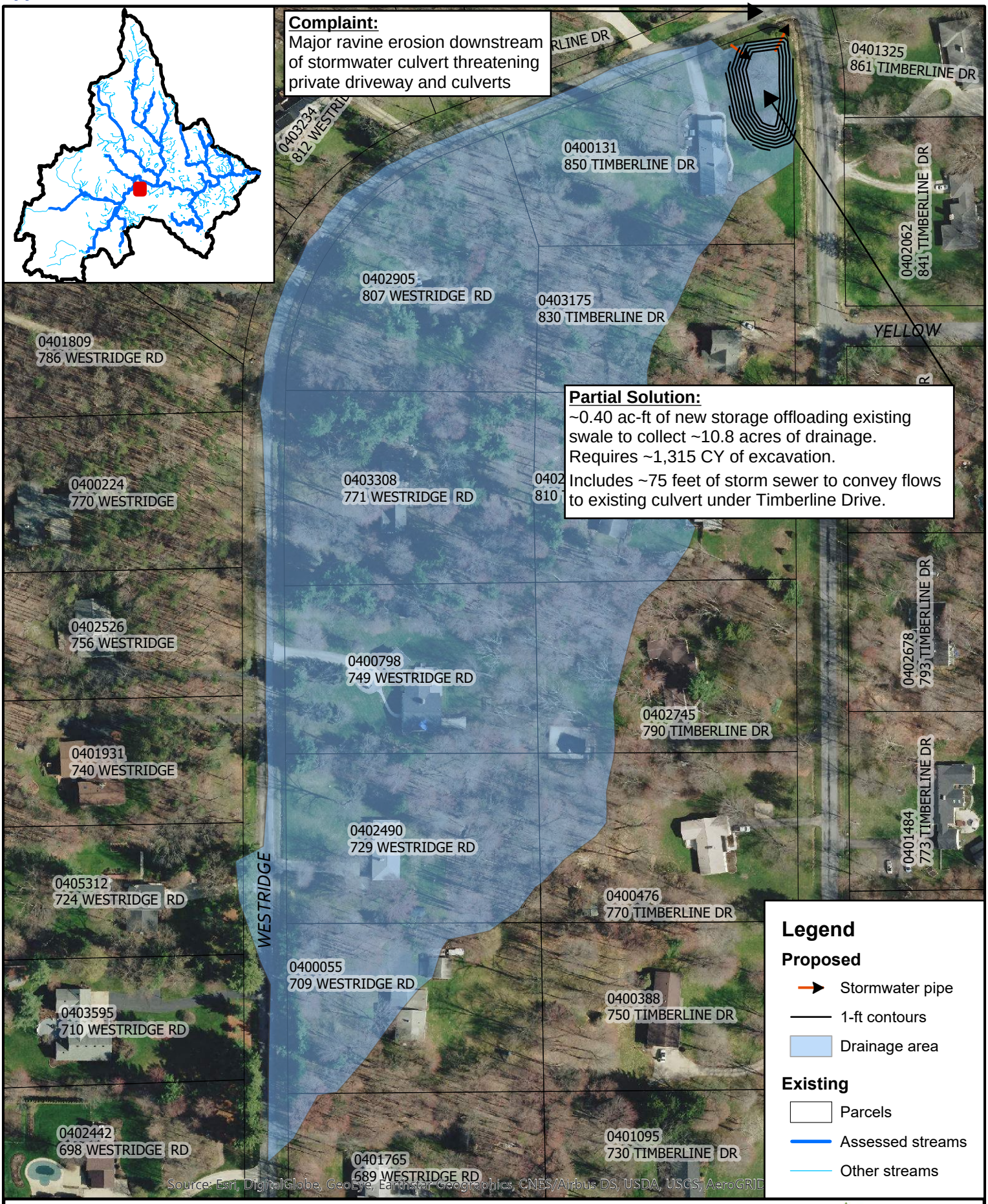
NEW STORMWATER CONTROL MEASURE

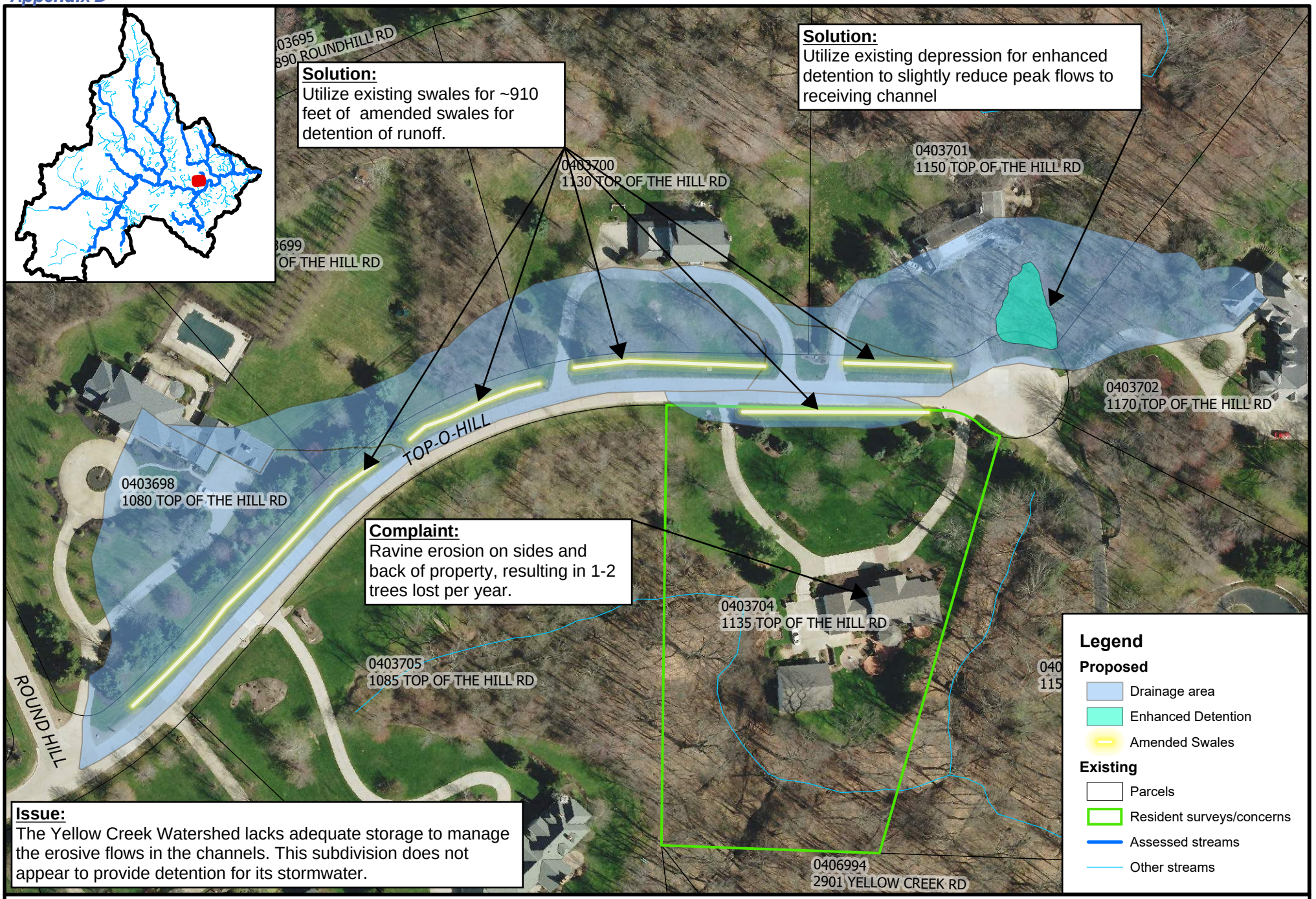
RANCHWOOD STORMWATER IMPROVEMENTS

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC


Complaint:
Major ravine erosion downstream of stormwater culvert threatening private driveway and culverts
Partial Solution:
~0.40 ac-ft of new storage offloading existing swale to collect ~10.8 acres of drainage. Requires ~1,315 CY of excavation.
Includes ~75 feet of storm sewer to convey flows to existing culvert under Timberline Drive.
0401325 861 TIMBERLINE DR
0403234 812 WESTRIDGE RD
0400131 850 TIMBERLINE DR
0402062 841 TIMBERLINE DR
0402905 807 WESTRIDGE RD
0403175 830 TIMBERLINE DR
YELLOW
0401809 786 WESTRIDGE RD
0400224 770 WESTRIDGE
0403308 771 WESTRIDGE RD
0402526 756 WESTRIDGE
0400798 749 WESTRIDGE RD
0402678 793 TIMBERLINE DR
0402745 790 TIMBERLINE DR
0401931 740 WESTRIDGE
0401484 773 TIMBERLINE DR
0402490 729 WESTRIDGE RD
WESTRIDGE
0405312 724 WESTRIDGE RD
0400476 770 TIMBERLINE DR
0400055 709 WESTRIDGE RD
0403595 710 WESTRIDGE RD
0400388 750 TIMBERLINE DR
0402442 698 WESTRIDGE RD
0401095 730 TIMBERLINE DR
0401765 689 WESTRIDGE RD
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID
Legend
Proposed
Stormwater pipe
1-ft contours
Drainage area
Existing
Parcels
Assessed streams
Other streams
N
0 50 100
Feet
NEW STORMWATER CONTROL MEASURE
TIMBERLINE PART A: DETENTION
BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT
SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT
Sustainable Streams LLC



N

0 50 100 Feet

NEW STORMWATER CONTROL MEASURE

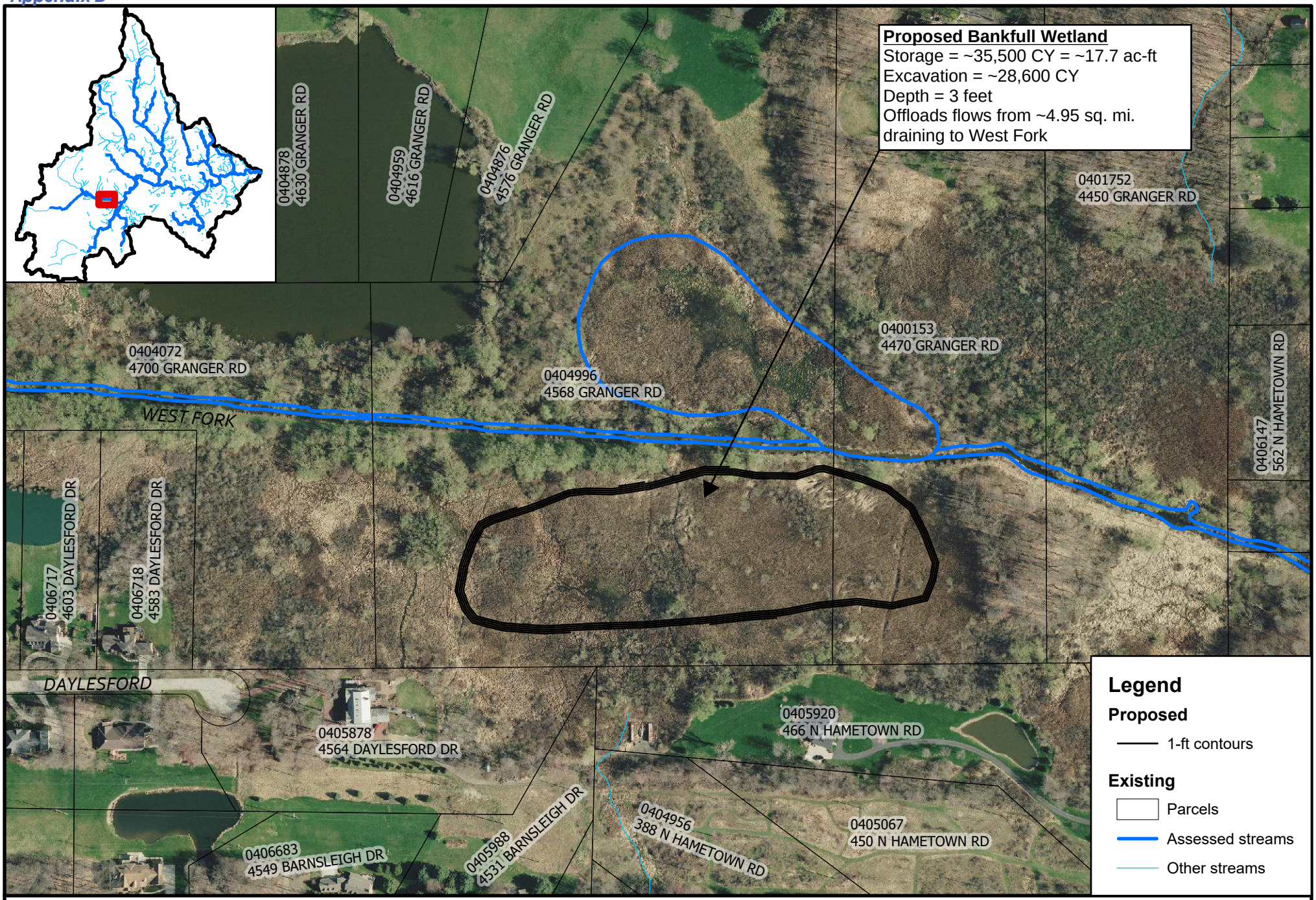
TOP OF THE HILL SITE DETENTION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Monday, July 8, 2019



N

0 100 200 Feet

NEW STORMWATER CONTROL MEASURE

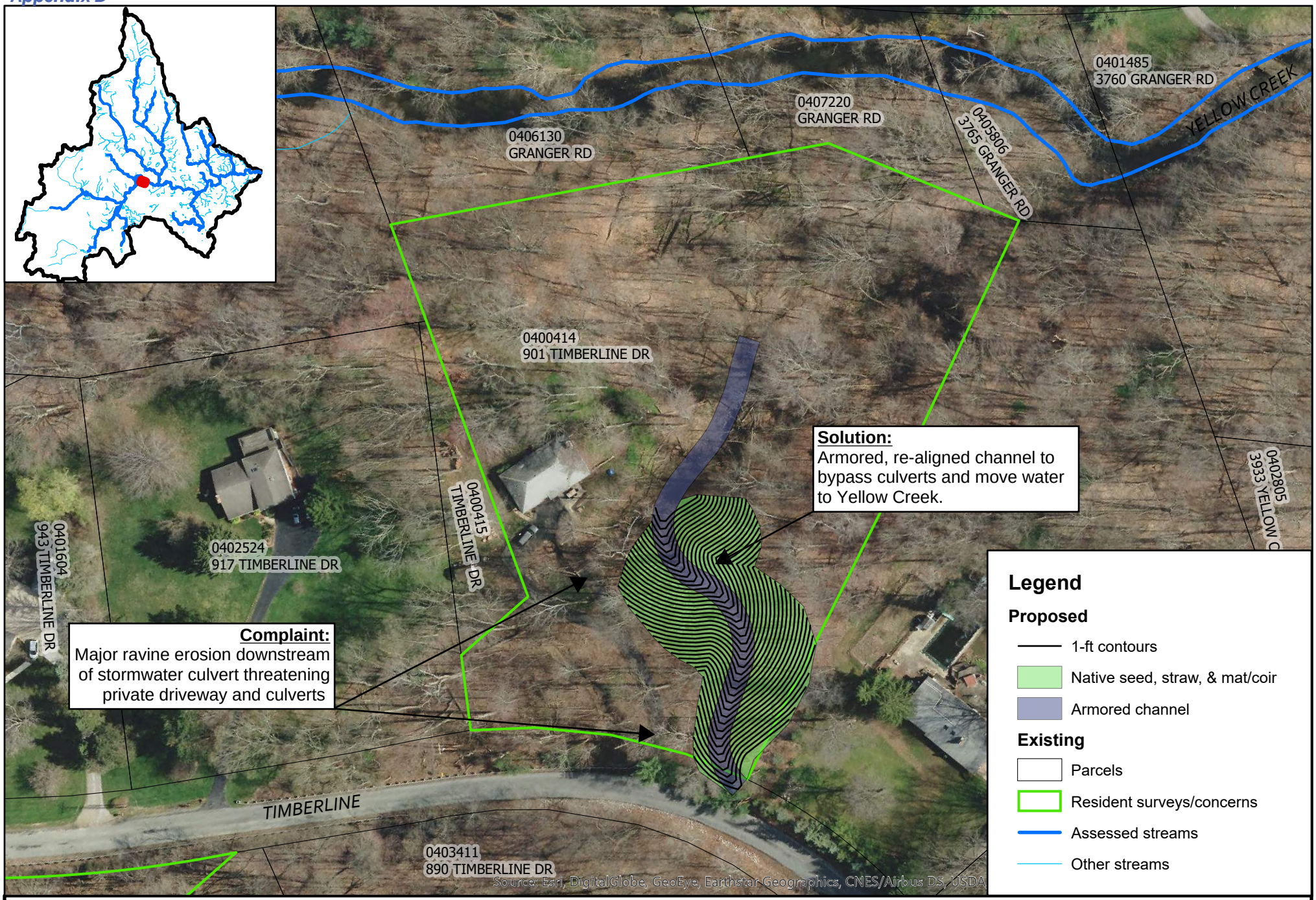
WEST FORK BANKFULL WETLAND

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Friday, July 5, 2019



STREAM STABILIZATION

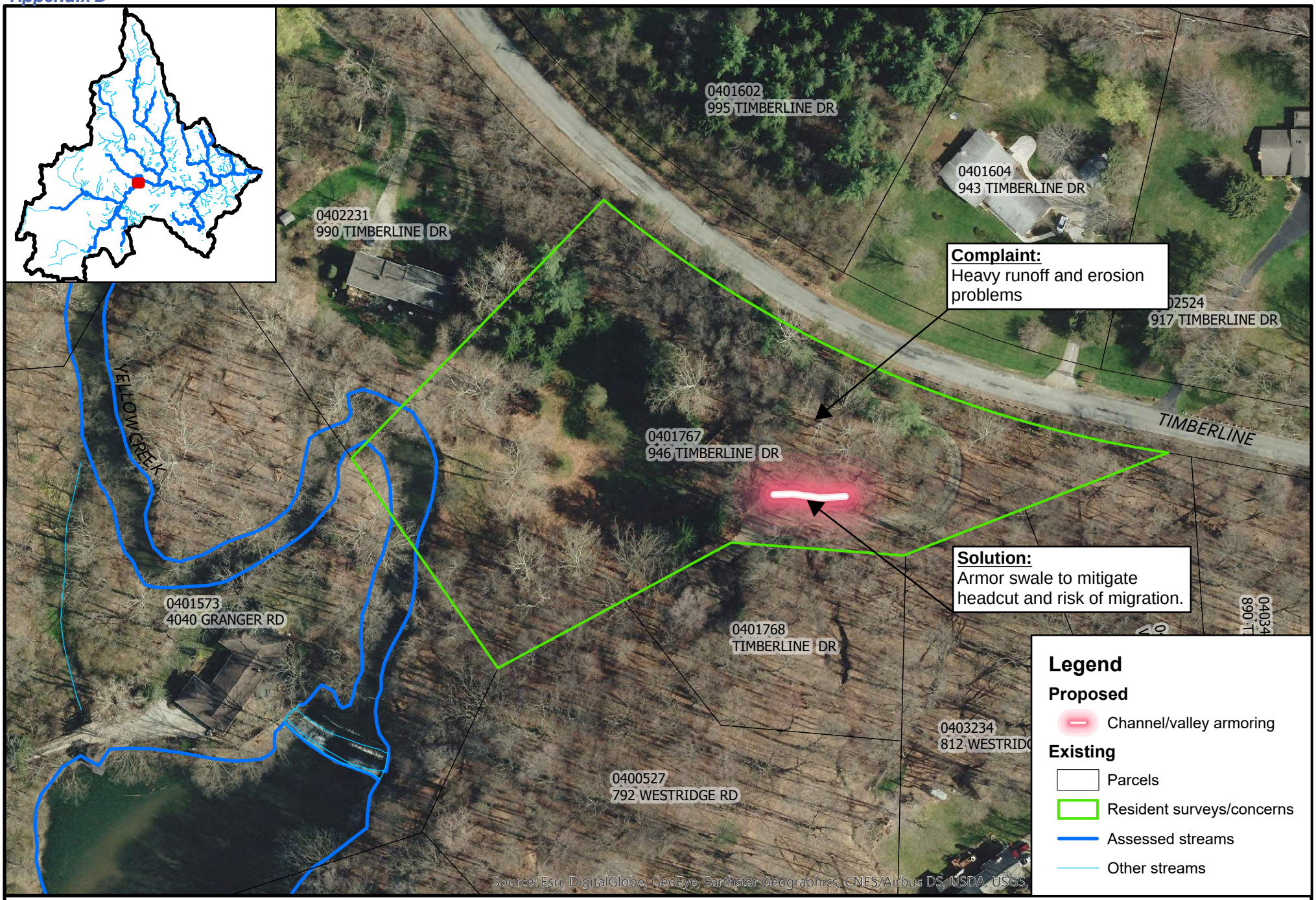
TIMBERLINE PART B: SWALE STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, September 3, 2019



STREAM STABILIZATION

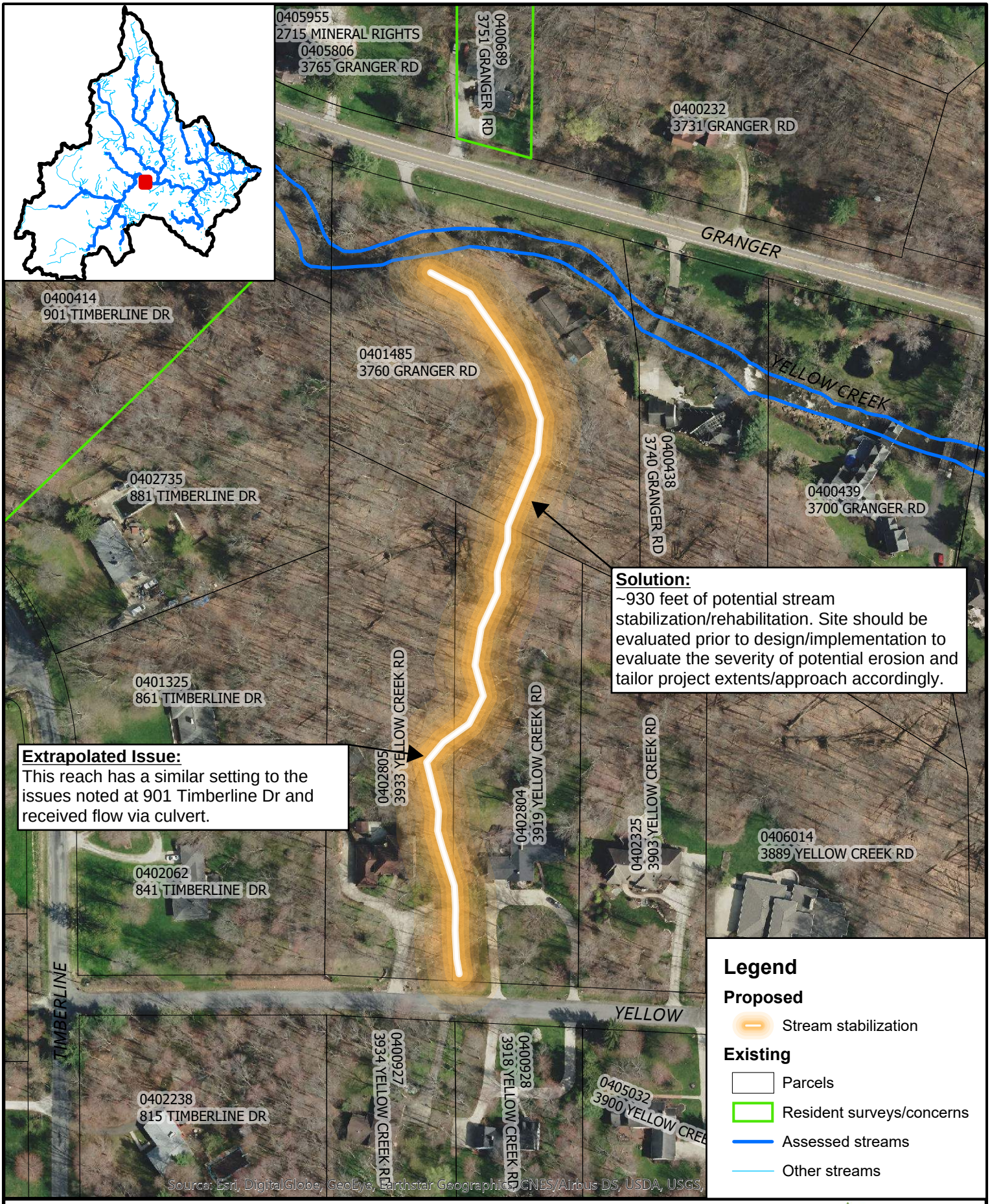
TIMBERLINE PART C: HEADCUT REPAIR

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, September 3, 2019



N

0 50 100 Feet

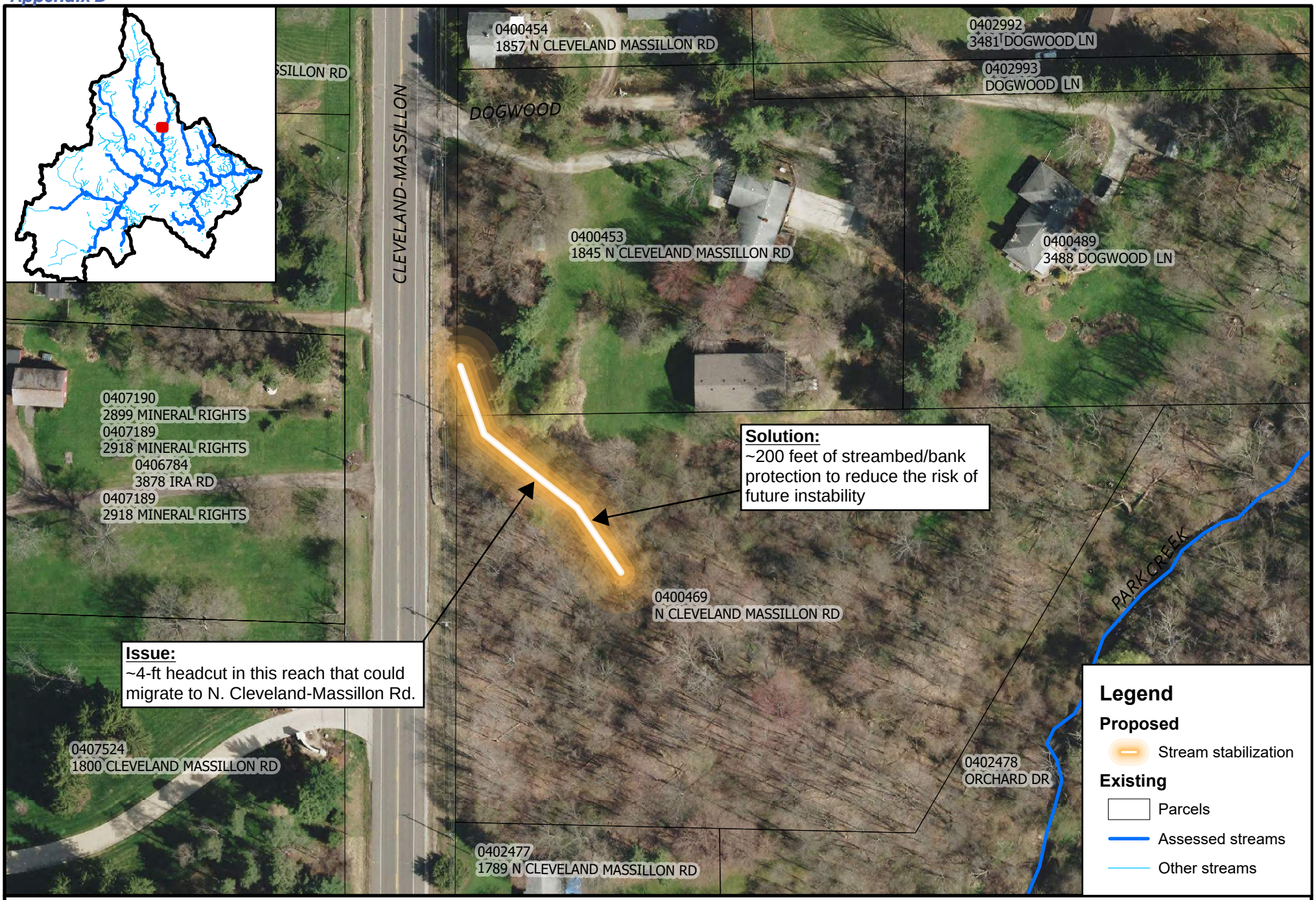
STREAM STABILIZATION

TIMBERLINE PART D: TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



STREAM STABILIZATION

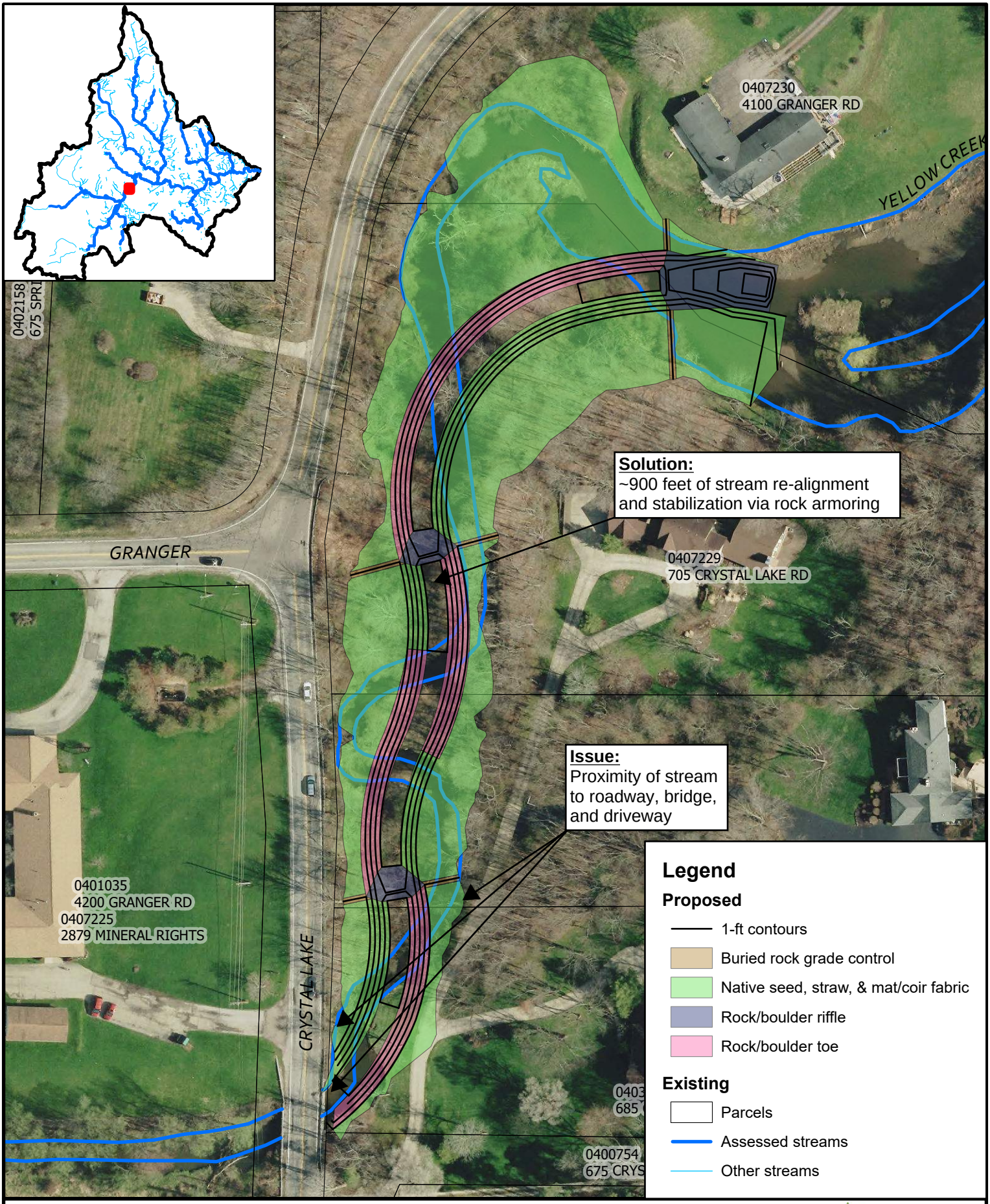
TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



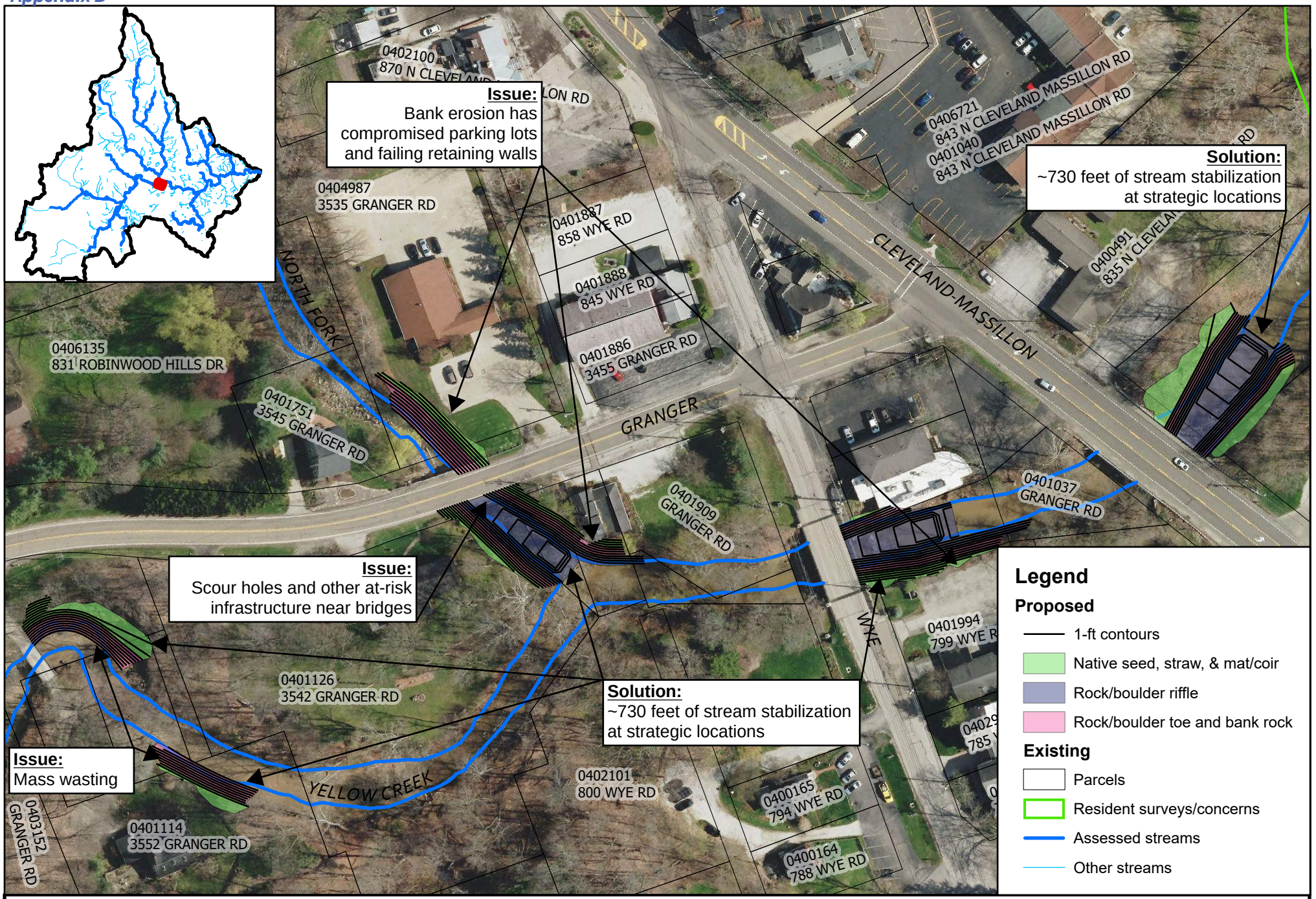
STREAM STABILIZATION

CRYSTAL LAKE STREAM RE-ALIGNMENT

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



N

0 50 100 Feet

STREAM STABILIZATION

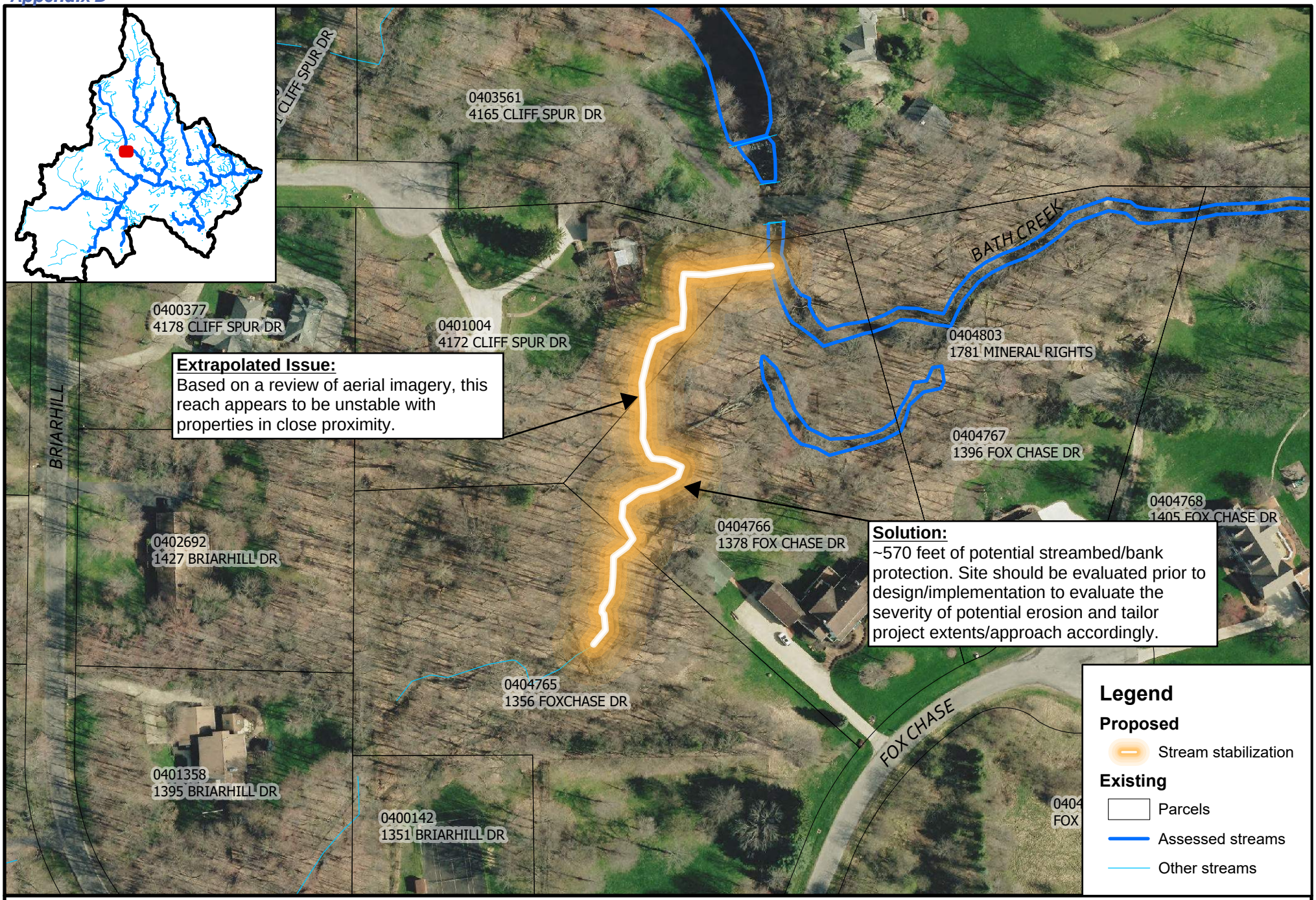
DOWNTOWN GHENT RESTORATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Saturday, July 6, 2019



STREAM STABILIZATION

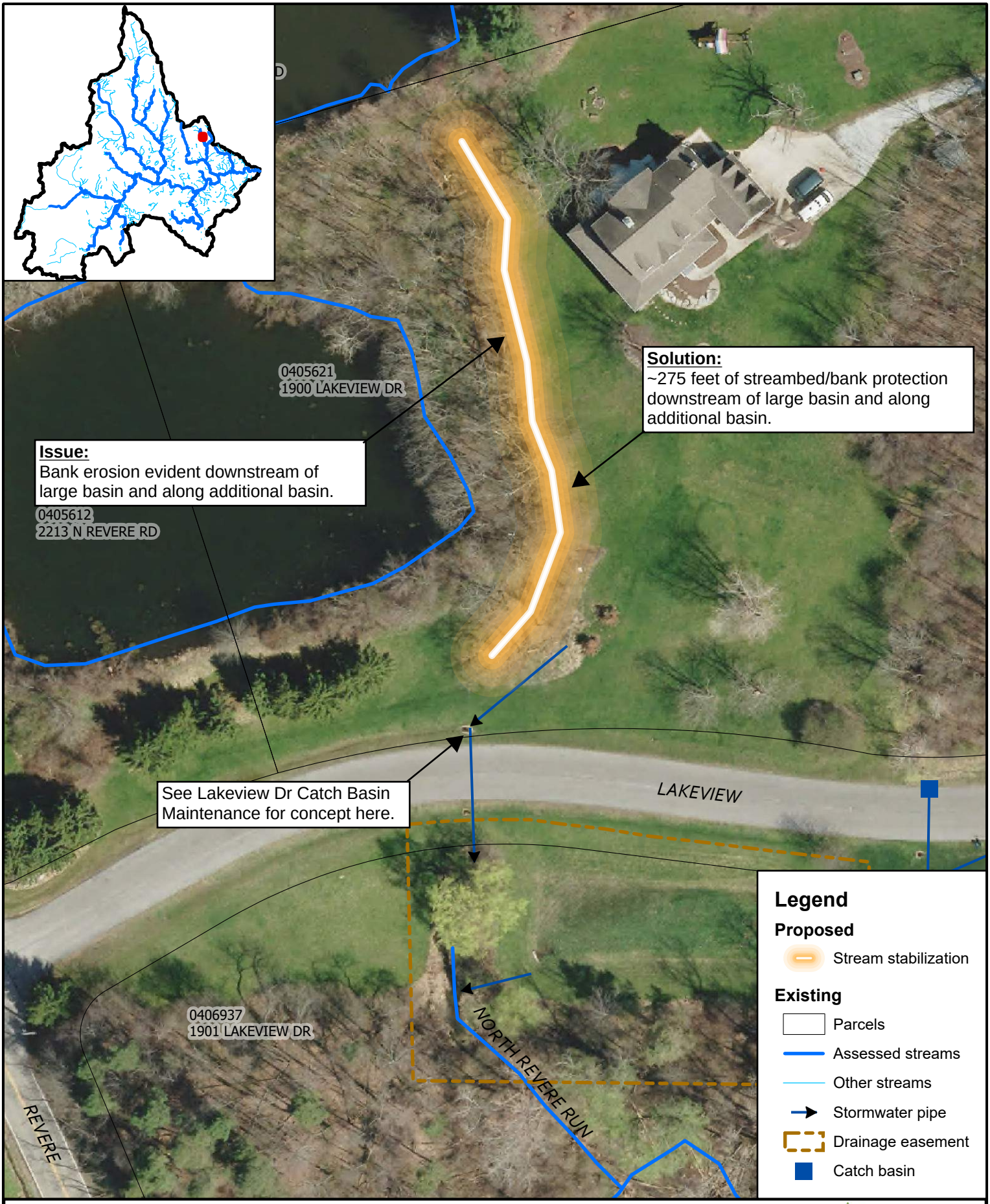
FOX CHASE TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



N

0 20 40 Feet

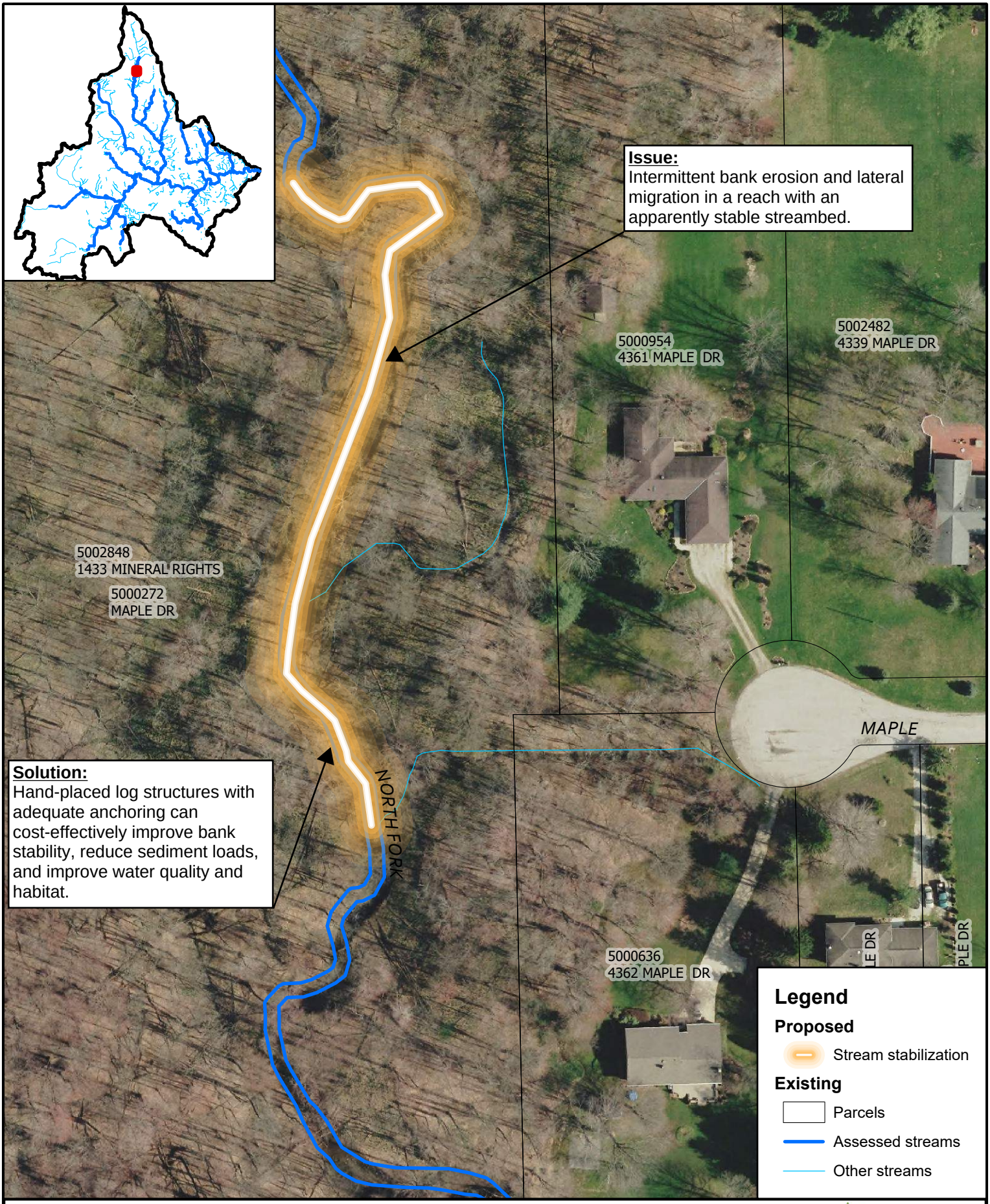
STREAM STABILIZATION

LAKEVIEW DR STREAM STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



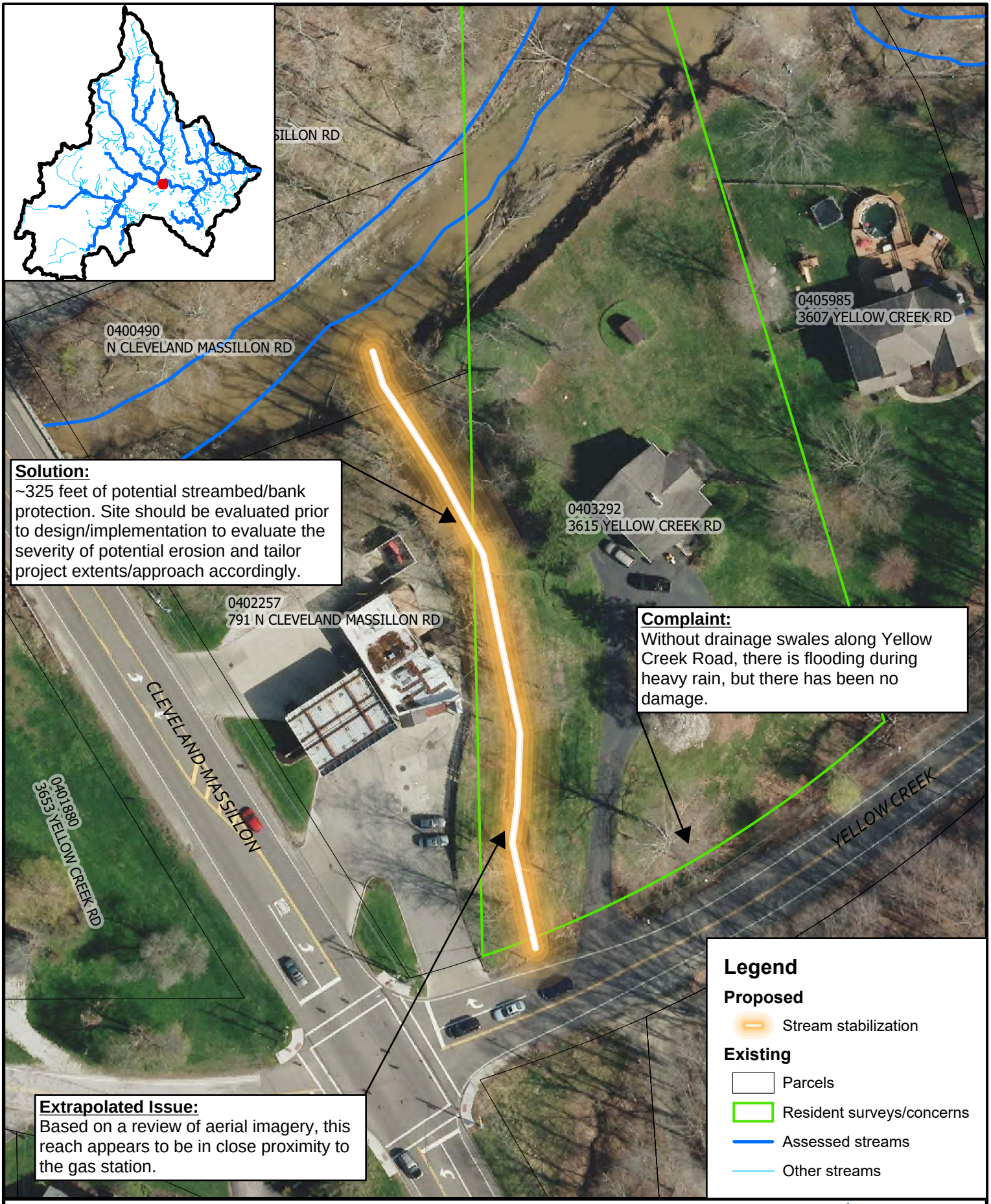
STREAM STABILIZATION

MAPLE DR HAND-PLACED LOG STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



N

0 40 80 Feet

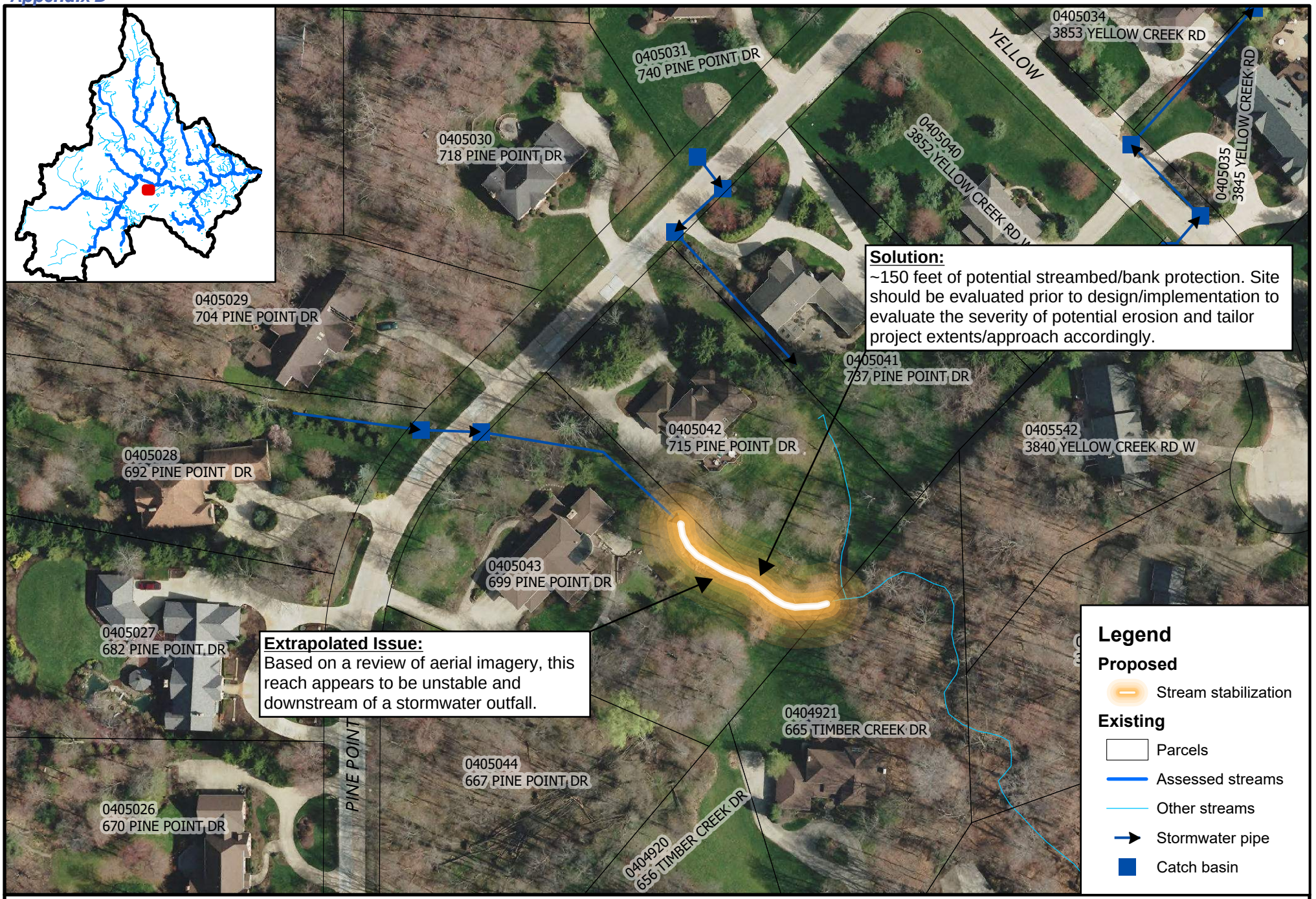
STREAM STABILIZATION

GHENT/YELLOW CREEK TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



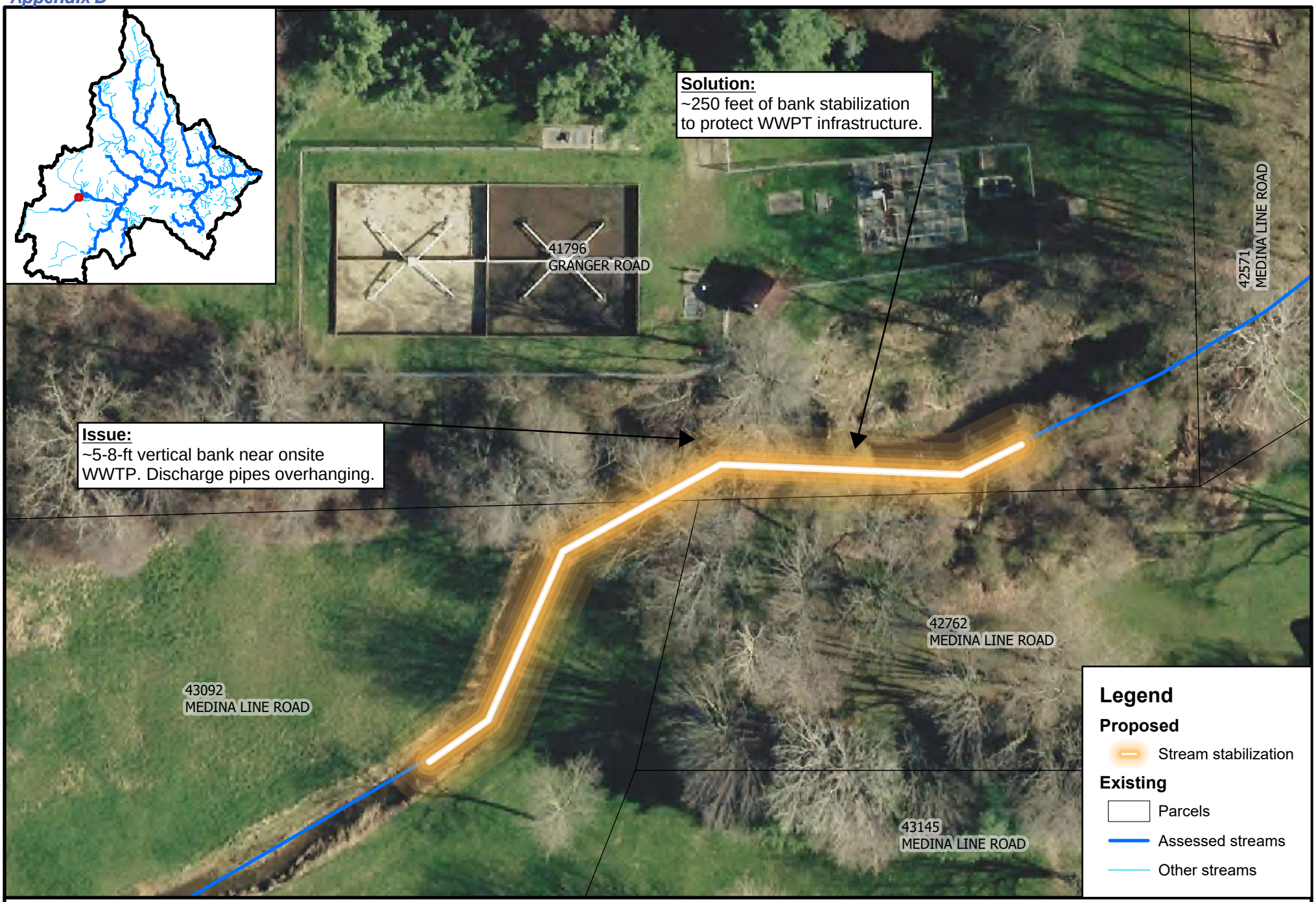
STREAM STABILIZATION

PINE POINT DRIVE OUTFALL CHANNEL STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



STREAM STABILIZATION

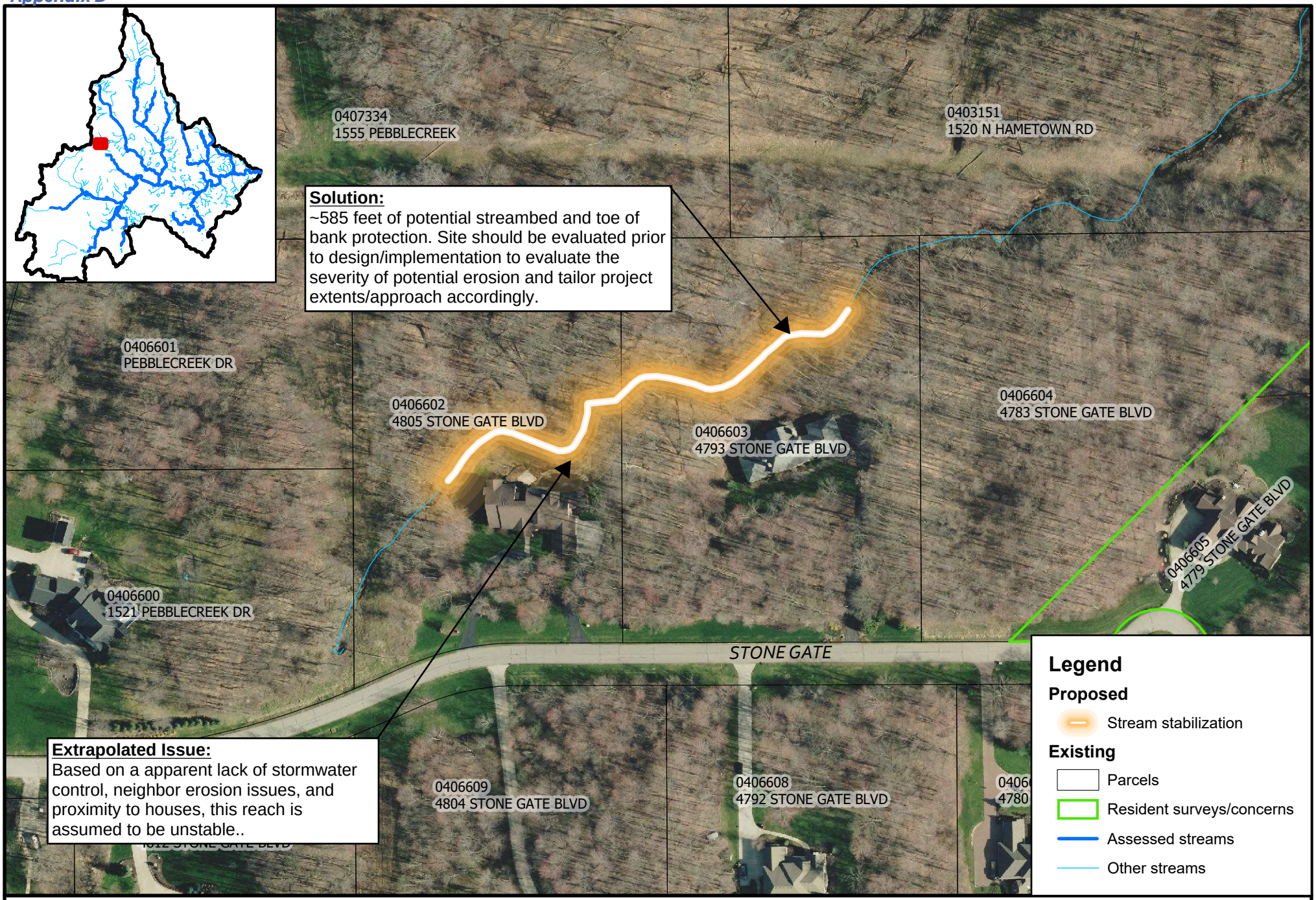
STABILIZATION NEAR WWTP

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



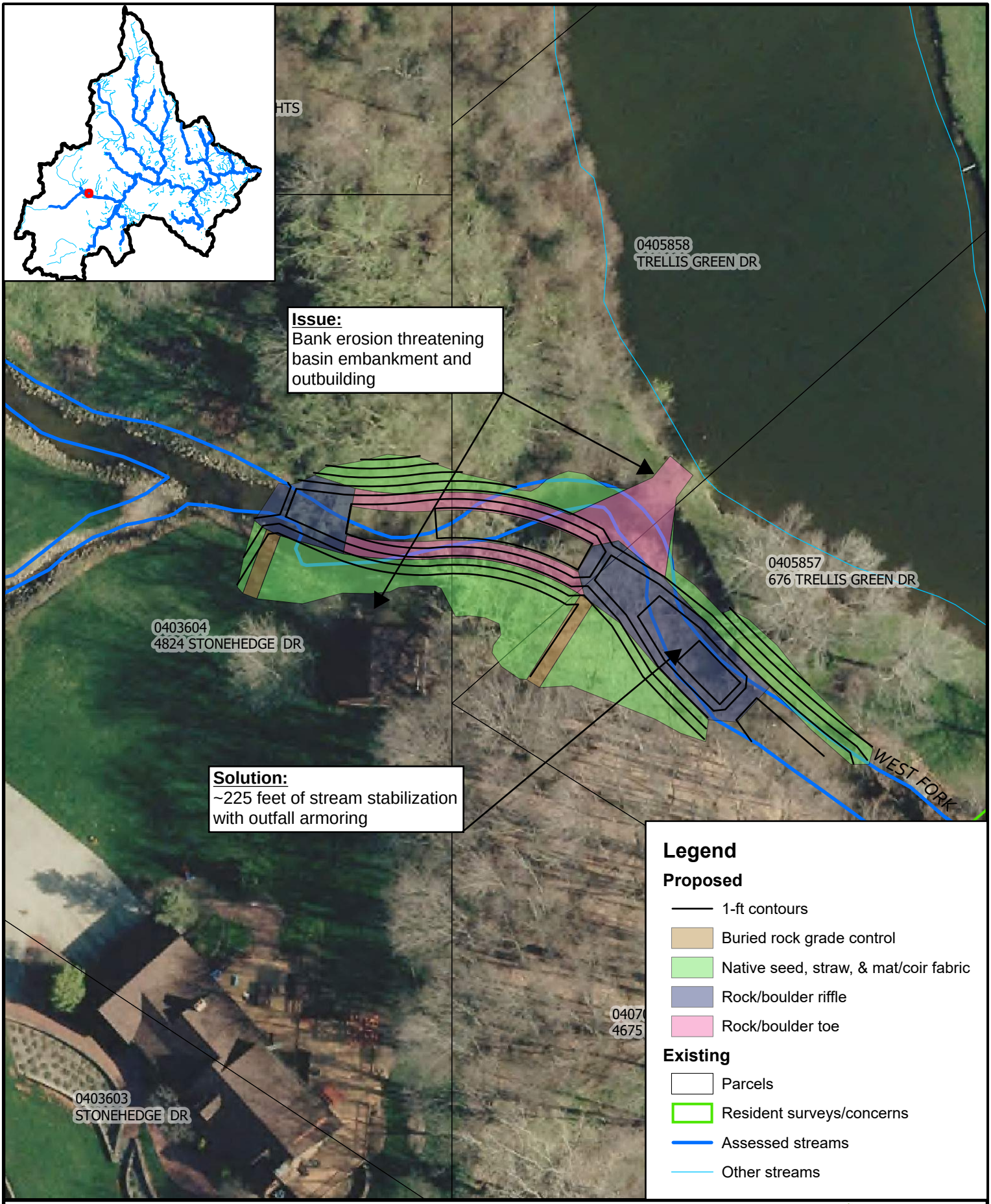
STREAM STABILIZATION

STONE GATE BLVD TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



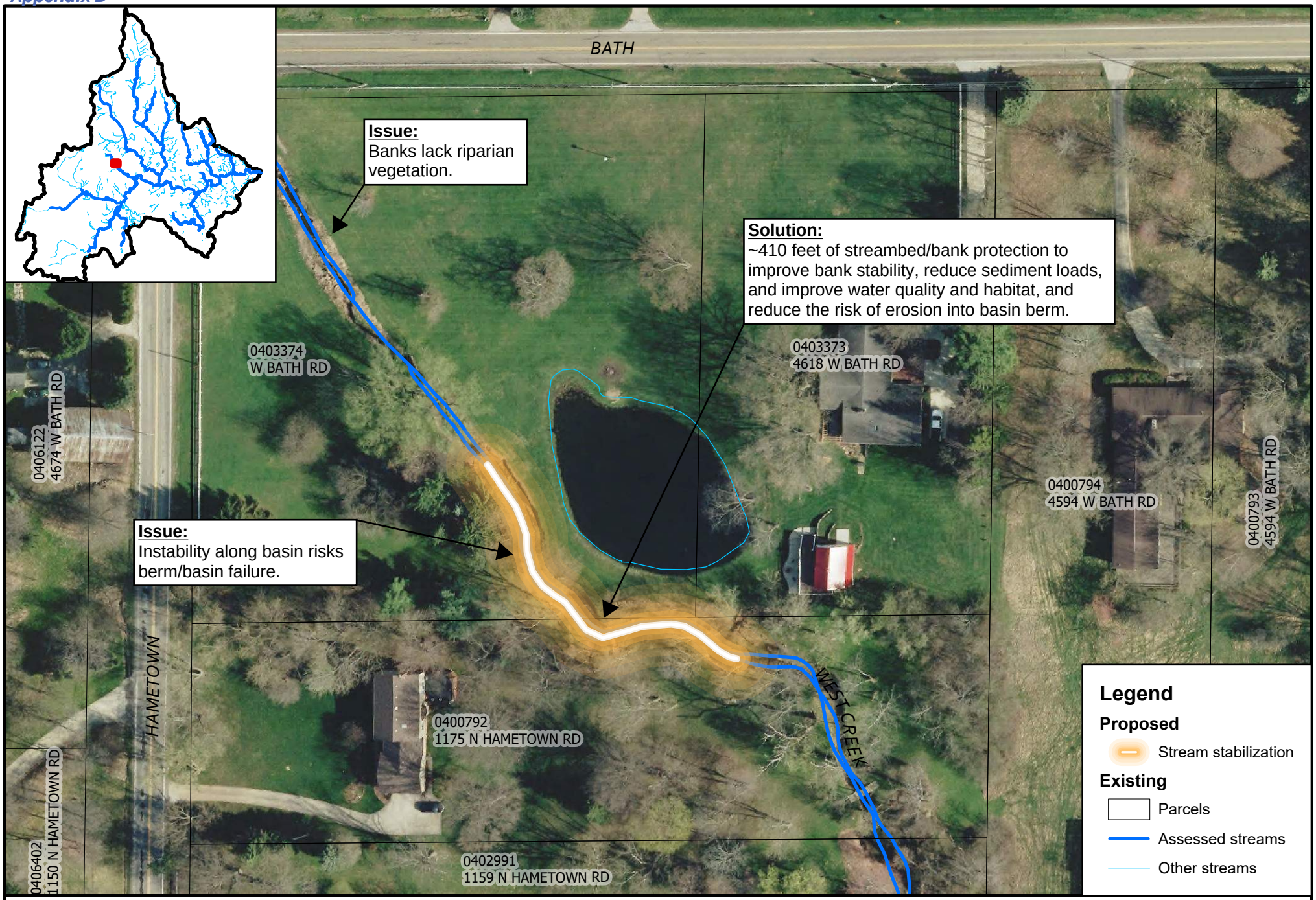
STREAM STABILIZATION

TRELLIS GREEN STREAM STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



STREAM STABILIZATION

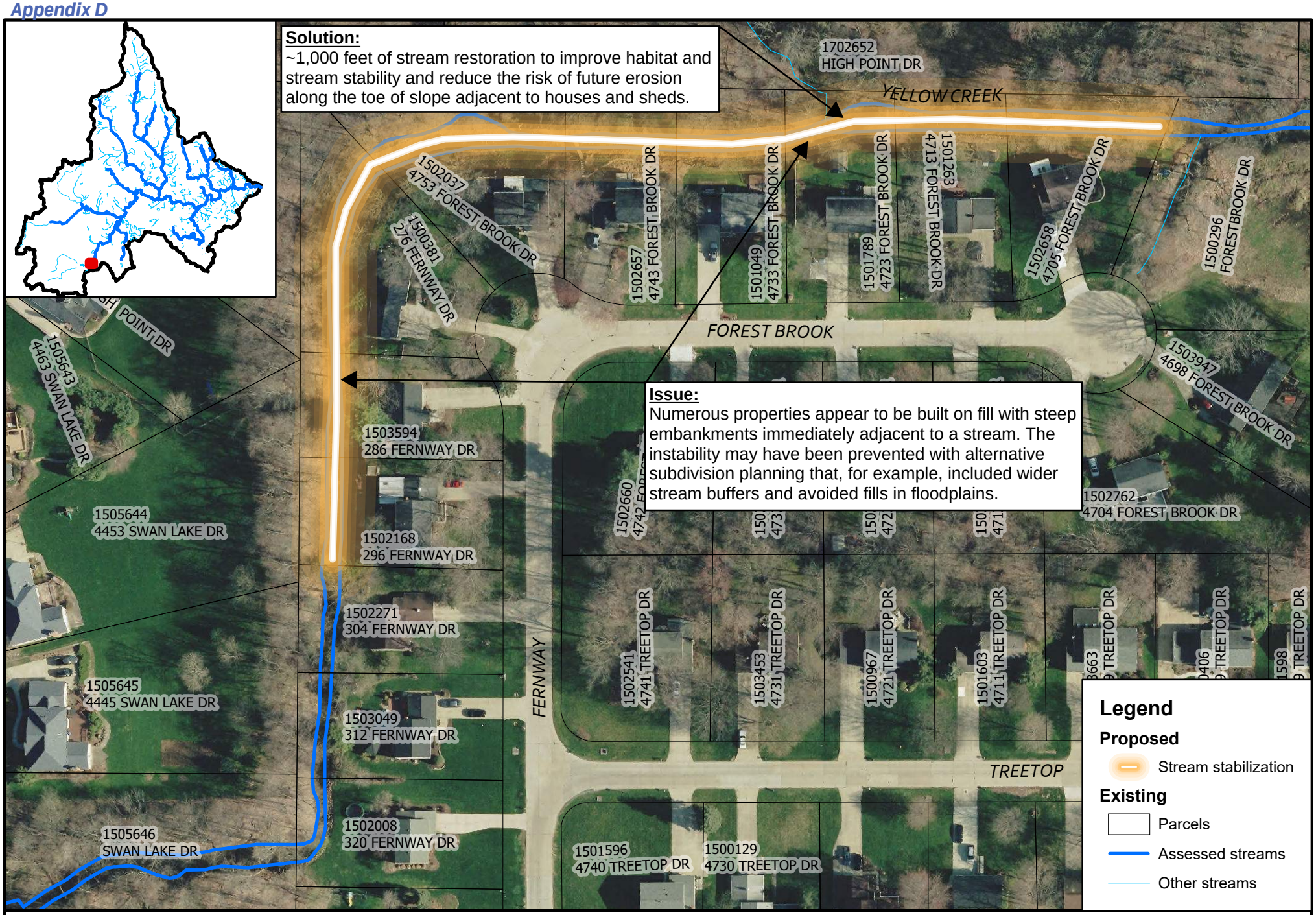
WEST CREEK STABILIZATION ALONG BASIN

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



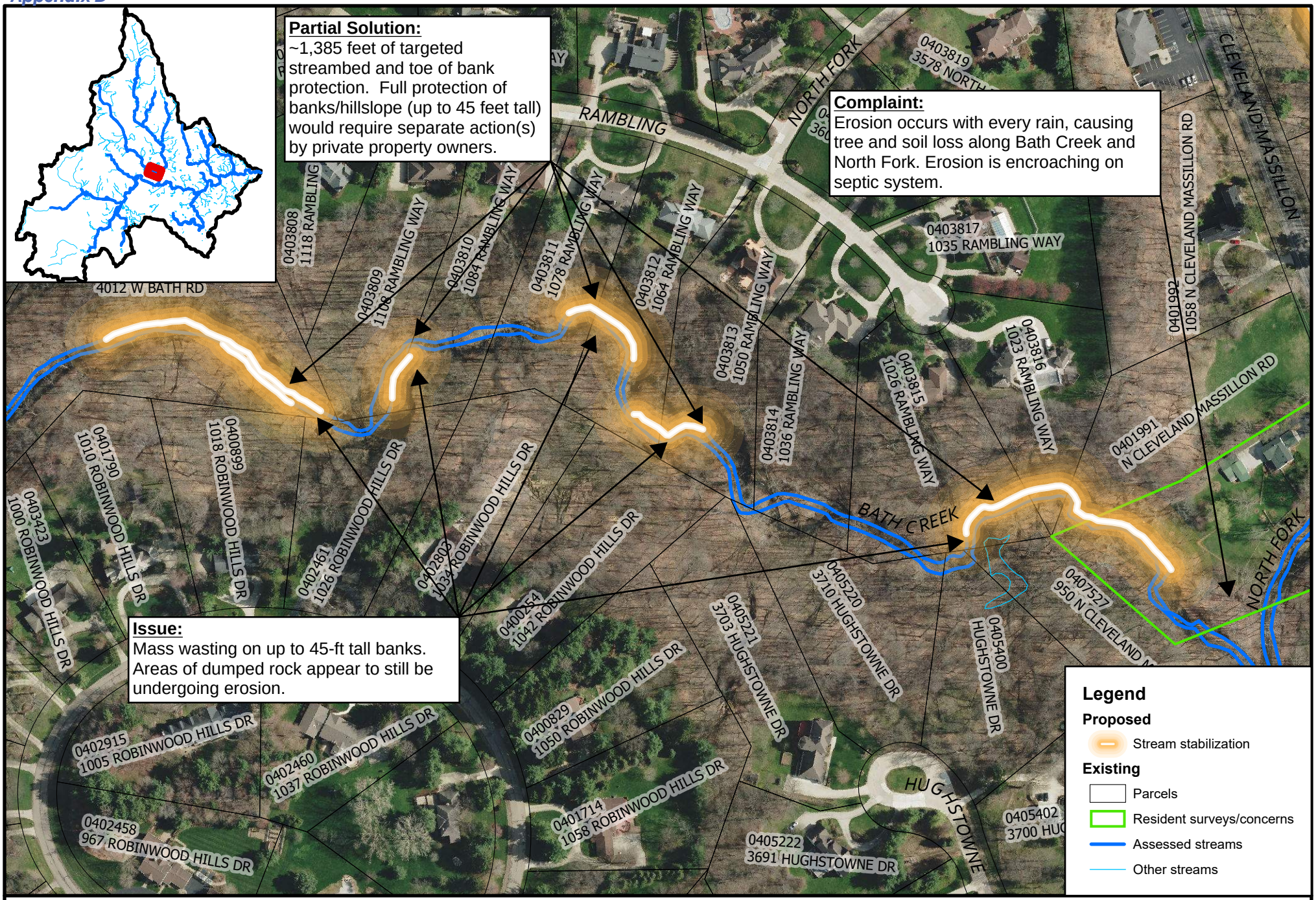
STREAM STABILIZATION

WESTMONT WOODS SUBDIVISION RESTORATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



N

0 100 200 Feet

STREAM STABILIZATION

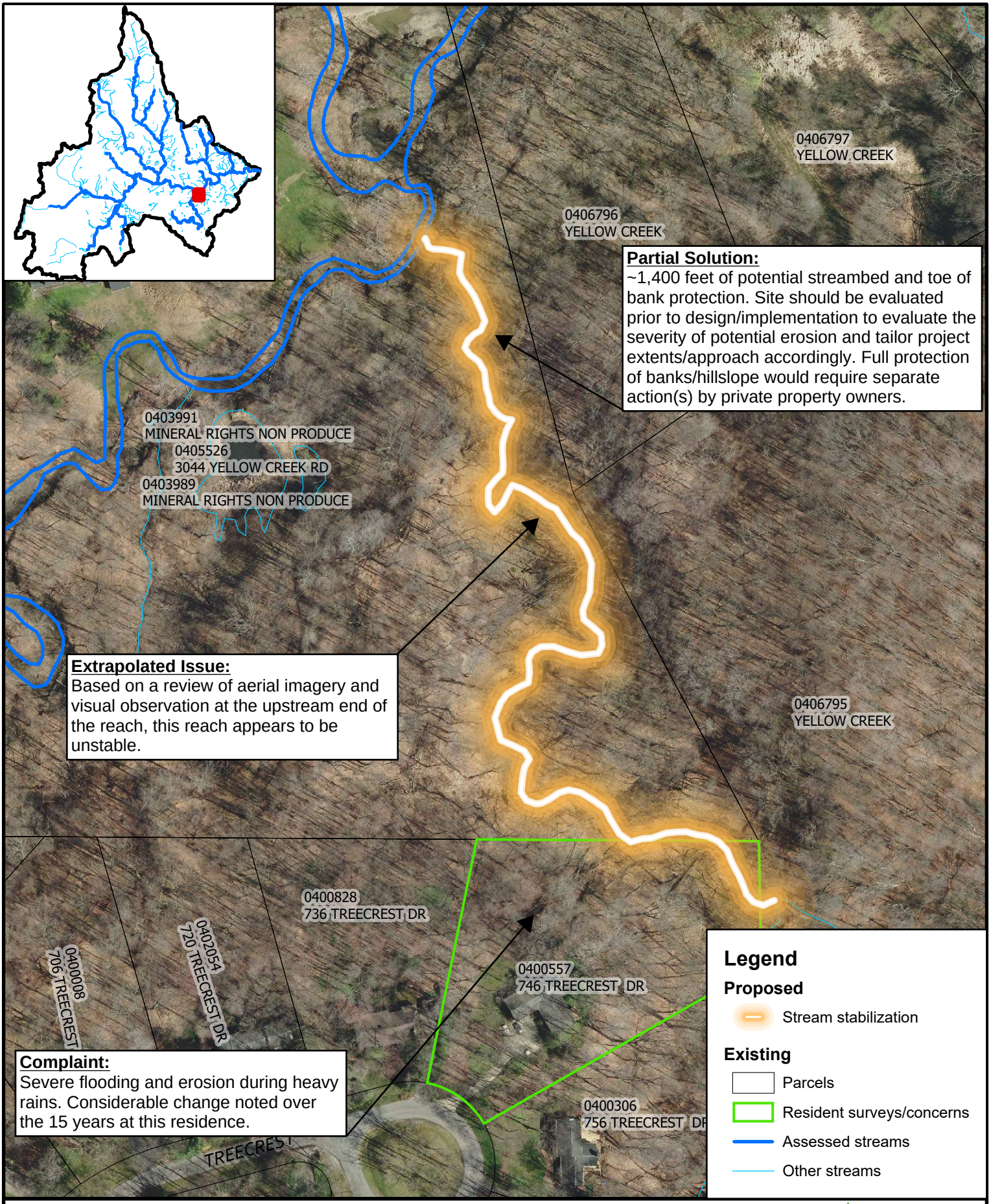
BATH CREEK SELECT STREAM STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



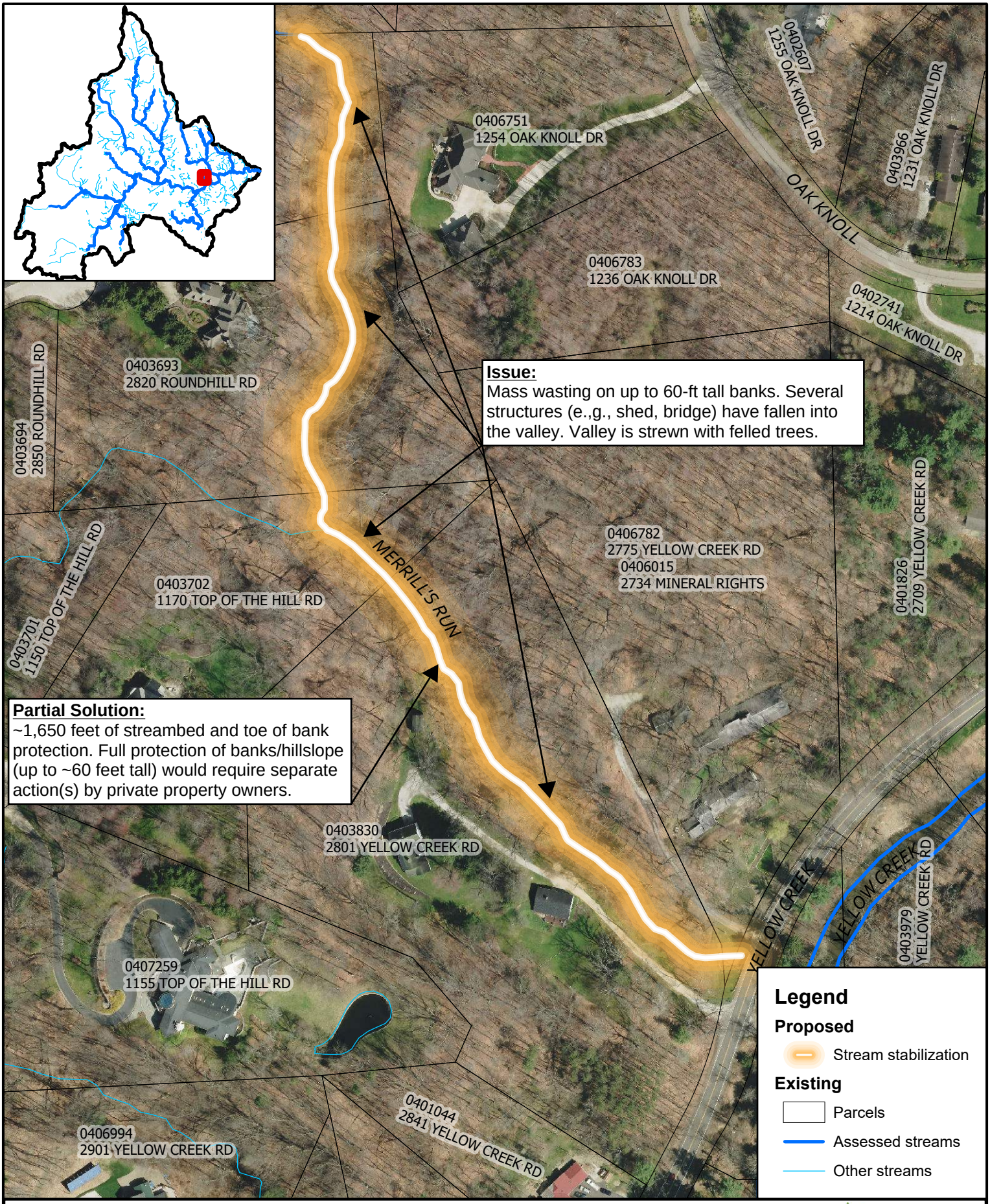
STREAM STABILIZATION

LOWER SOUTH FORK TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



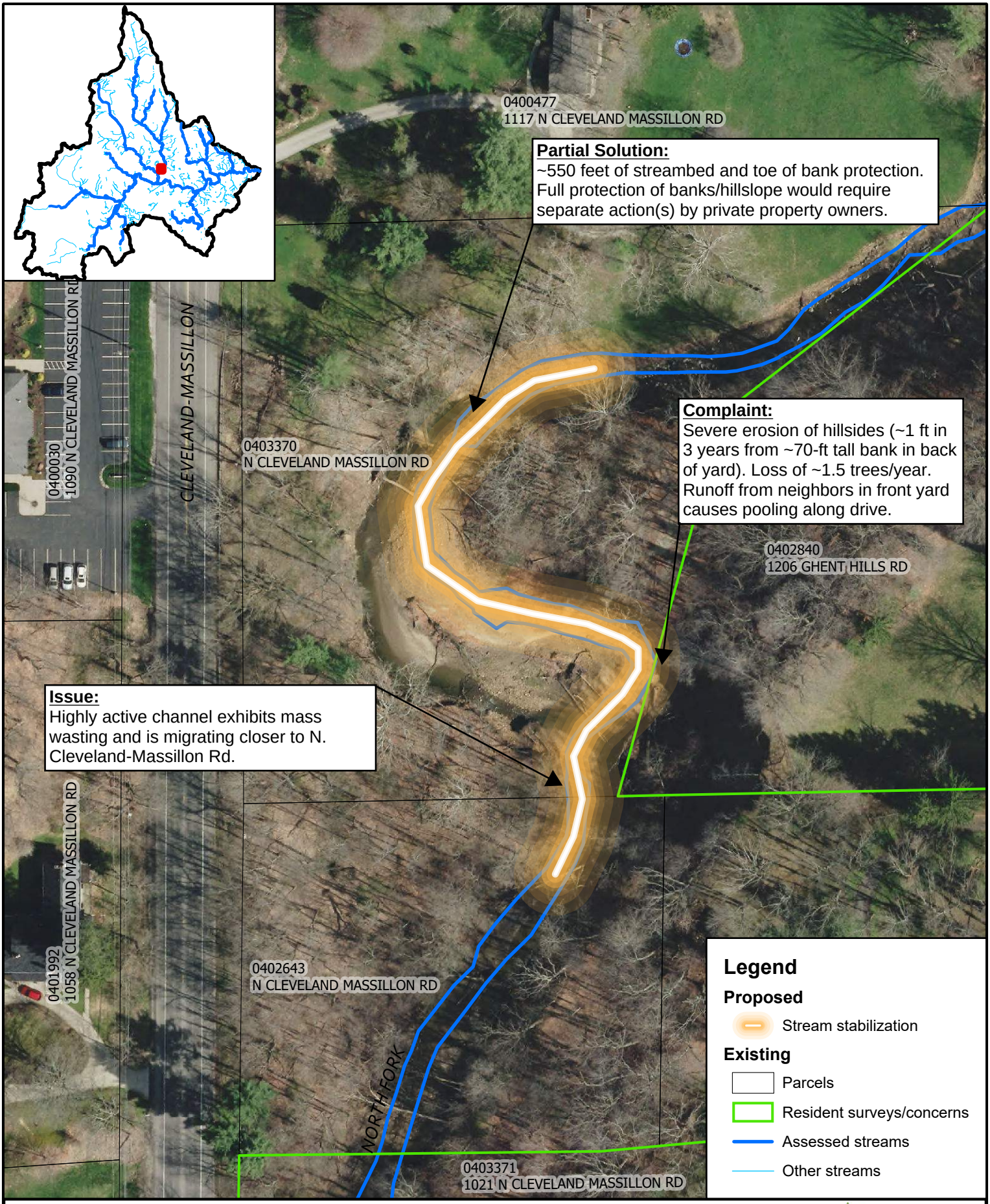
STREAM STABILIZATION

MERRILL'S RUN STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



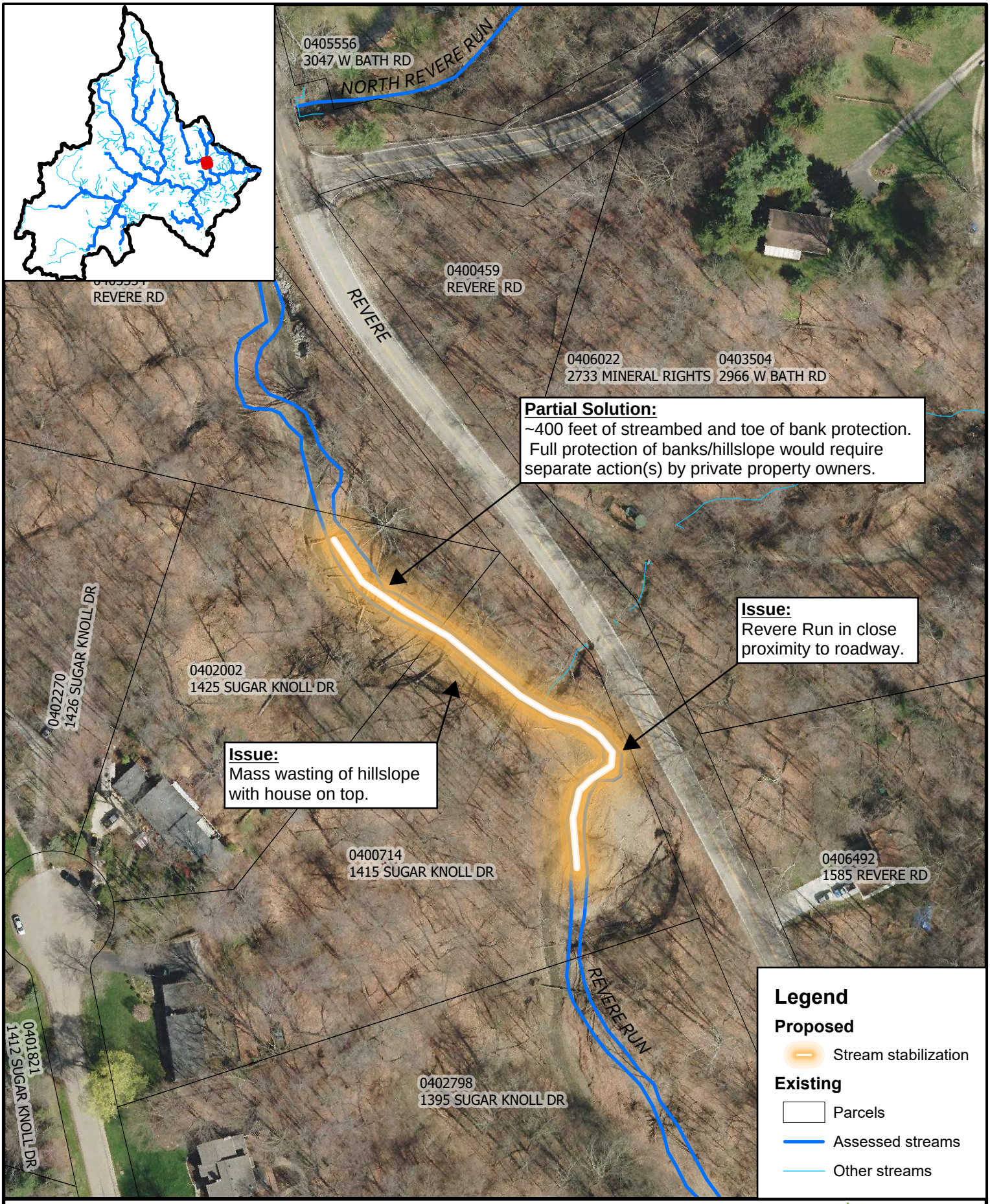
STREAM STABILIZATION

NORTH FORK STREAM RE-ALIGNMENT

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



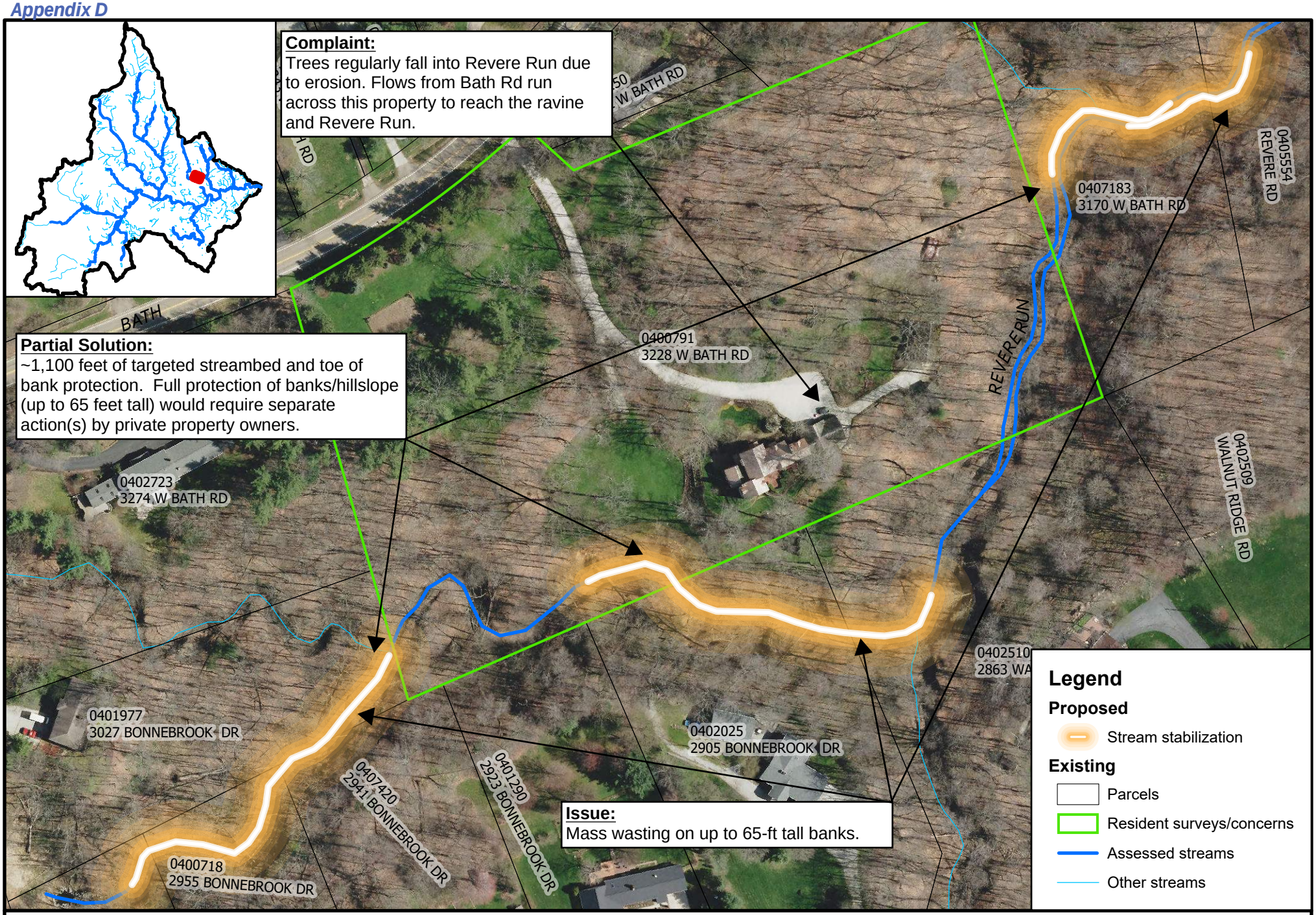
STREAM STABILIZATION

REVERE RD STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



STREAM STABILIZATION

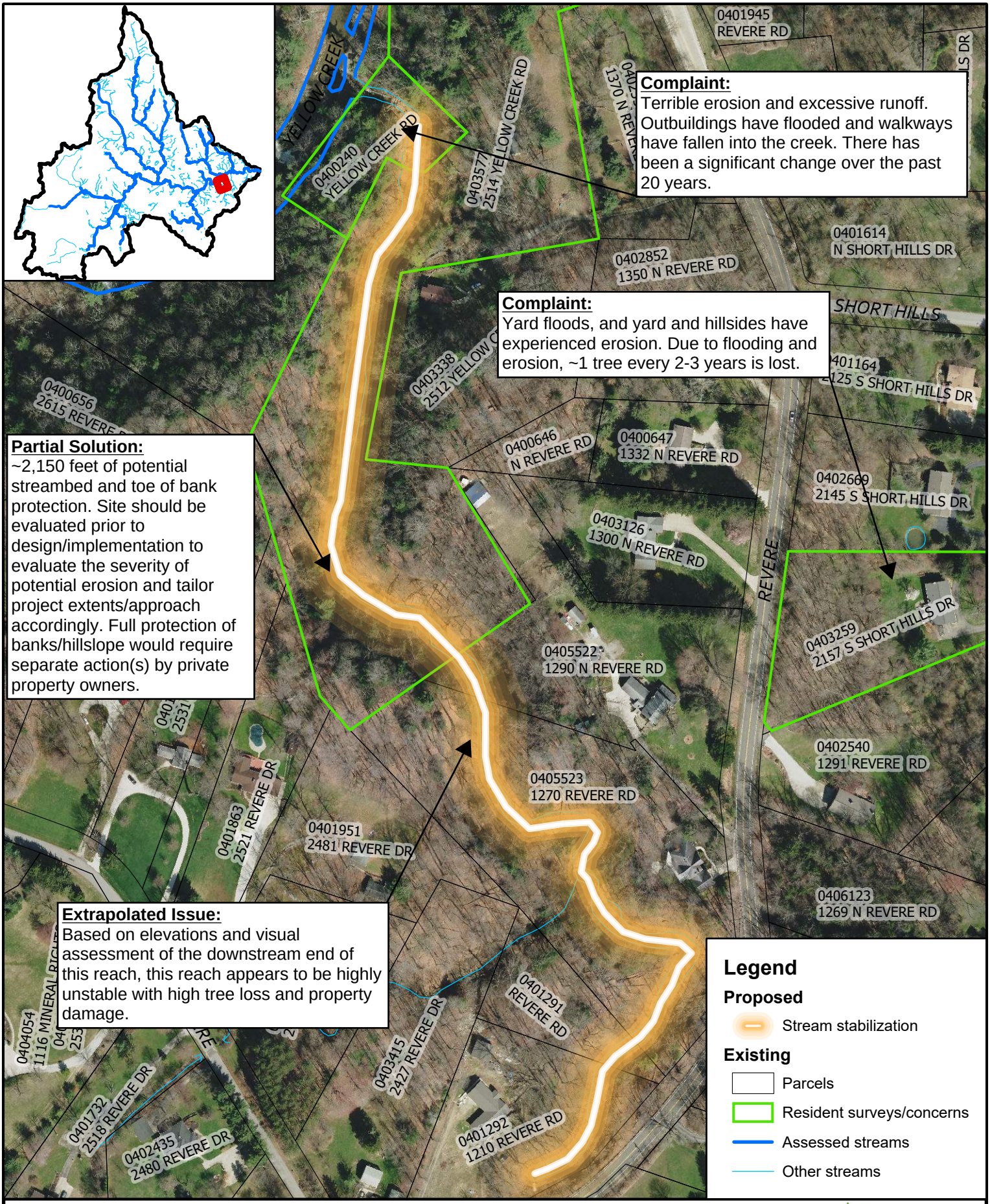
REVERE RUN SELECT STREAM STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



N

0 100 200 Feet

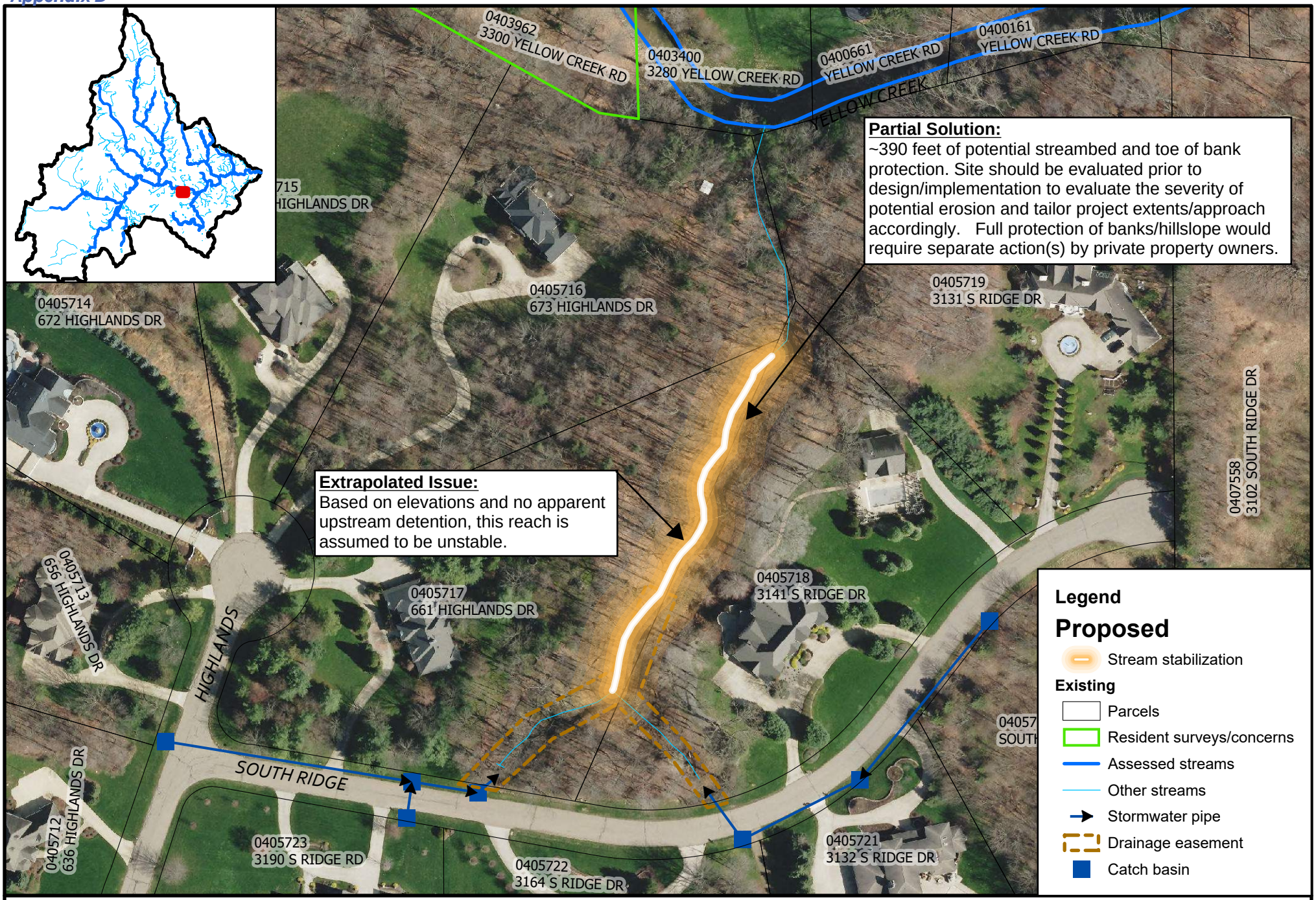
STREAM STABILIZATION

REVERE RD TO YELLOW CREEK TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



STREAM STABILIZATION

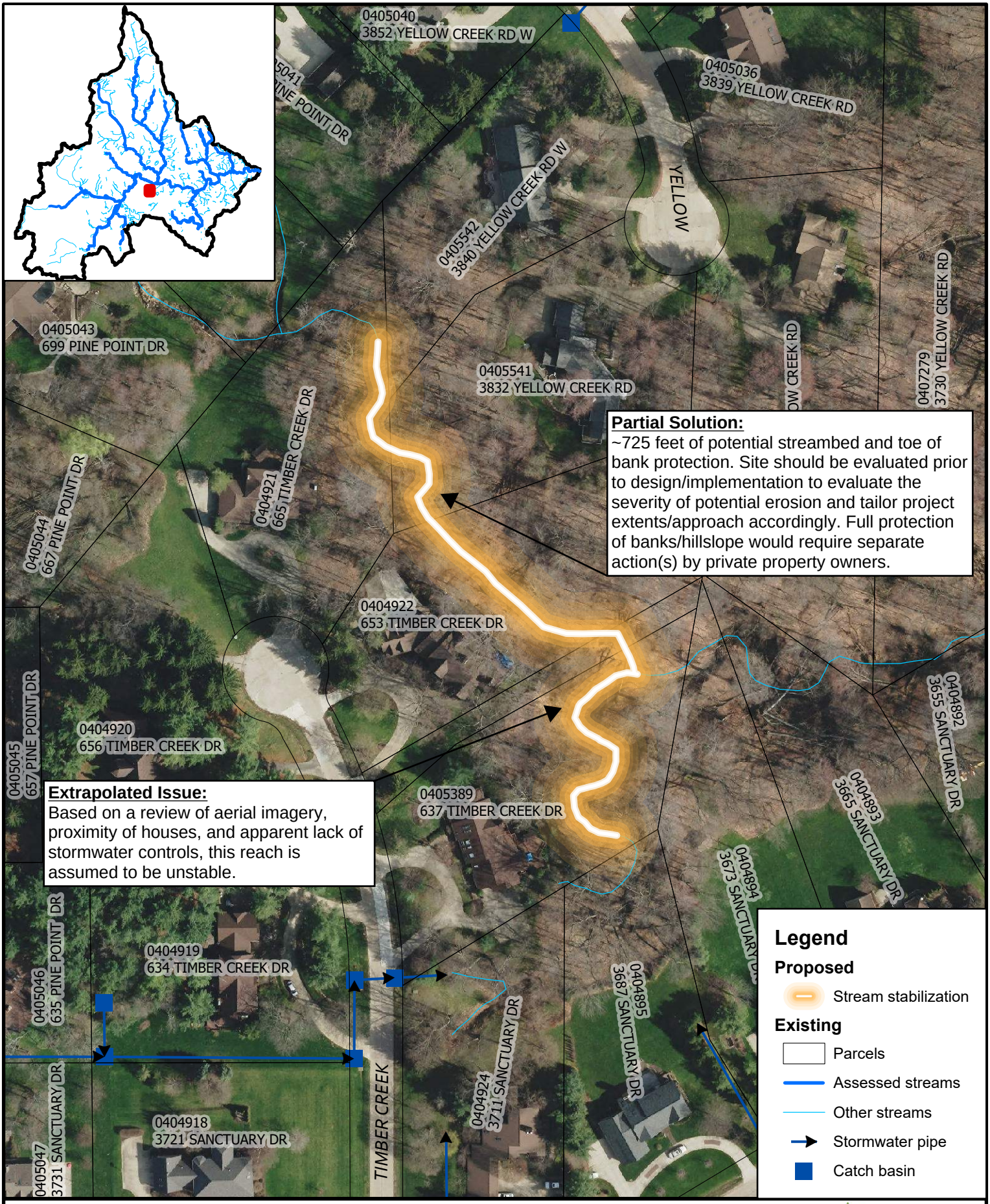
RIDGE DRIVE TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



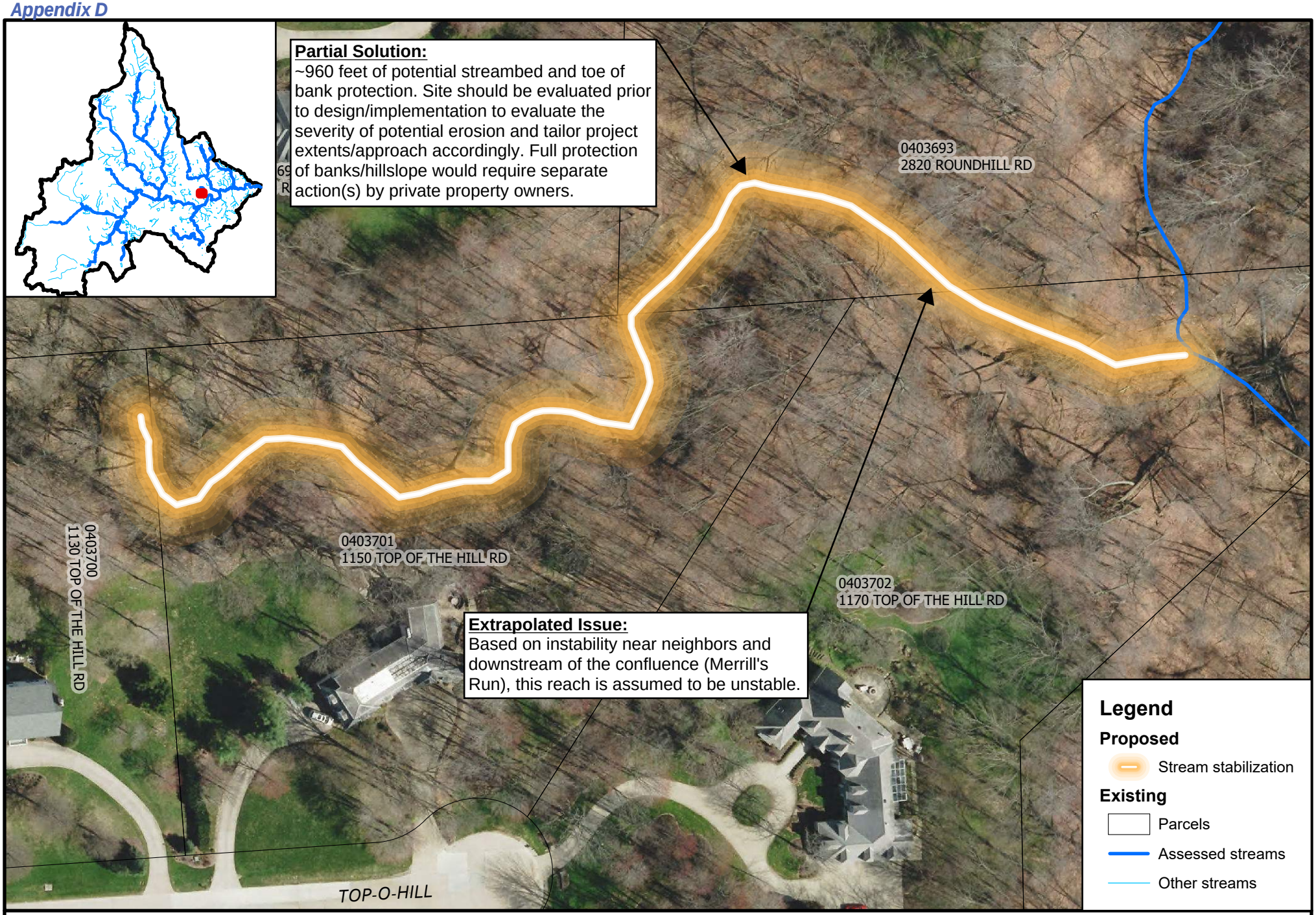
STREAM STABILIZATION

TIMBER CREEK DRIVE TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC



N

0 50 100 Feet

STREAM STABILIZATION

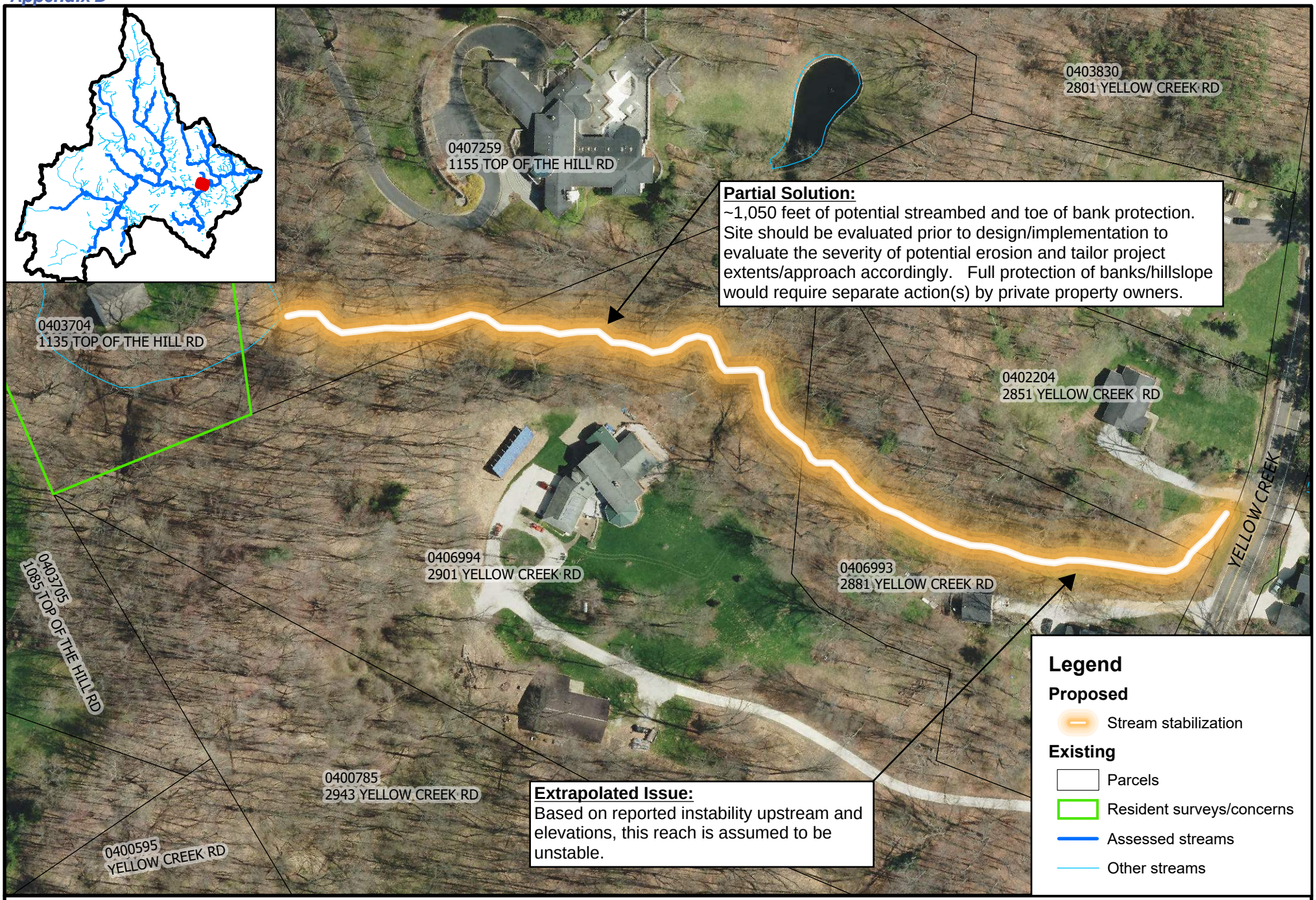
TOP OF THE HILL NORTH TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



STREAM STABILIZATION

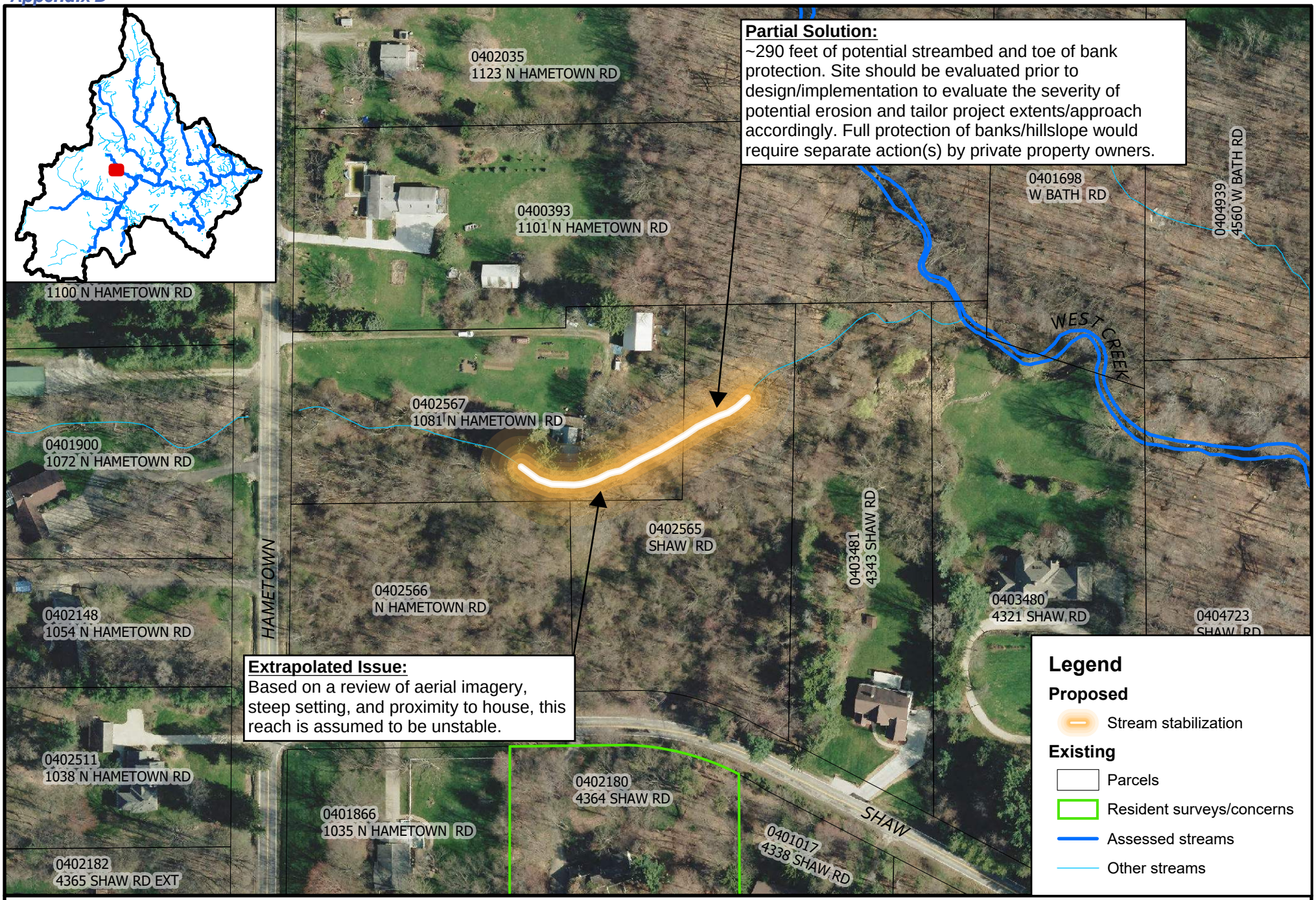
TOP OF THE HILL SOUTH TRIBUTARY STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

Last Updated On: Tuesday, July 9, 2019



STREAM STABILIZATION

WEST CREEK TRIBUTARY TO HAMETOWN RD STABILIZATION

BATH TOWNSHIP DRAINAGE BASIN IMPROVEMENT

SUMMIT COUNTY SURFACE WATER MANAGEMENT DISTRICT

Sustainable Streams LLC

APPENDIX E

Helpful Resources

CITY OF FLORENCE KENTUCKY®

Keep it Clean
We all live downstream!

Taking it to the Streets
Streambank Edition

WHAT?

Streambank erosion workshop. The Do's and Dont's of streambank maintenance.

WHEN?

Wednesday, October 4th, 2017
5:00p.m.—7:00p.m. EST

WHERE?

13 Kennedy Court, Florence KY

Parking also available on Lakeshore Dr.

WHY?

To provide residents with steps to manage and reduce problems resulting from stormwater runoff.

WHO?

Residents of Florence, especially those with streams on their property.

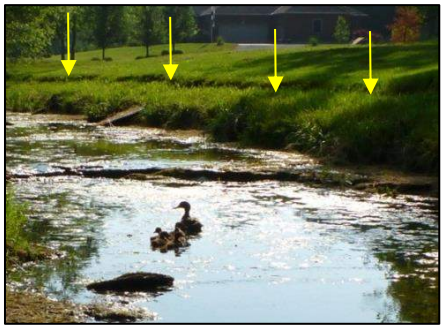
FOOD WILL BE PROVIDED BY CITY OF FLORENCE.

Contact Adam Engels @ 859-647-5416 for additional information.

Streambank Workshop

October 4, 2017
City of Florence & Sustainable Streams, LLC

What is stream erosion? *Northern Kentucky has many streams that are adjusting to increased stormwater runoff from impervious surfaces such as rooftops, roads, and driveways. Streams become larger to accommodate more water just as a human body becomes larger when the input calories exceed the expended calories. The increased erosive flows cause streams to become deeper and wider.*



Stream erosion may start as a tension crack along the bank (left) that eventually leads to bank collapse and widening (right)

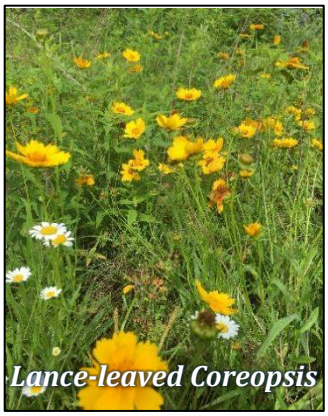
Examples of erosion prevention practices:

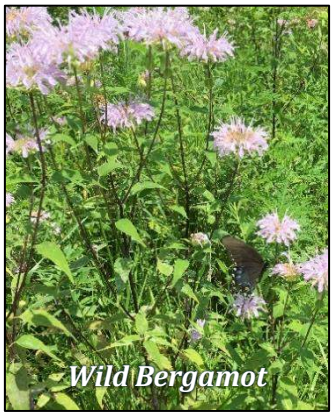
- *Establish native riparian vegetation*
- *Remove invasive species such as Honeysuckle*
- *Do not regularly mow to the edge of the bank*
- *Do not dump yard waste into the stream*
- *Harvest and plant livestakes*
- *Anchor logs or rocks along the bank*
- *Re-grade the bank to a 4:1 slope (or gentler)*

NOTE: Do not use equipment in streams without approval from regulatory agencies

Stabilized bank with re-graded 4:1 slopes and riparian vegetation

Native plants can provide bank stability and polinator habitat





Invasive honeysuckle shades out stablizing ground cover

Avoid mowing to the edge of streams


Blackeyed Susan


Greyheaded & Eastern Purple Coneflowers

Examples of Native Riparian Vegetation Species:

*Contact the **Boone County Conservation District** for guidance on removal of invasive species as well as establishment and maintenance of native riparian vegetation: **Mark Jacobs, (859) 586-7903***

- ***Seed Mixes:***

  Contact your local nursery or native plant specialist for native seed mixes that are best suited for your site.

  Native plant specialists:

  Cardno Native Plant Nursey (574) 586-2412
  Ernst Seeds (800) 873-3321
  Ohio Prairie Nursery (330) 569-3380
  Roundstone Native Seed, LLC (270) 531-3034
  Spence Restoration Nursery Inc. (765) 286-7154

  Local nurseries may also carry native seed:

  Baeten's Nursery (859) 384-4769
  Reminiscent Herb Farm (859) 525-8729

- ***Shrubs:***

  Swamp rose
  Northern spicebush
  Silky dogwood
  Chokecherry
  Allegheny serviceberry
  American hazelnut
  Downy serviceberry
  Gray dogwood

- ***Trees:***

  Swamp white oak
  American beech
  Northern red oak
  American sycamore
  Black gum
  Sugar maple

- ***Livestakes:***

  Arrowwood
  Black willow
  Buttonbush
  Elderberry
  Ninebark
  Red-osier dogwood
  Silky dogwood
  Silky willow

Livestakes can add root strength to banks

Livestakes can be purchased from a nursery or harvested from existing shrubs. Install them 2-3 feet apart in a triangular pattern. Use a rebar to dig a pilot hole and insert the livestakes halfway into the soil. Leaf growth may not be observed during the first growing season when roots are becoming established, but should be evident by the second growing season.


Livestake installation

Anchored logs can improve bank stability

Logs can be ramped and anchored next to existing trees along a bank or installed at the toe of an unstable bank to reduce erosion. Wood stakes can be used to keep the logs from floating away.

Live Staking Vegetation

Bank stabilization

Lake friendly living means using lakeshore BEST MANAGEMENT PRACTICES

BMP

Live Staking Vegetation

STANDARDs

Shorefront

- Stable bank
- Natural conditions

LAKE BENEFITS

Healthy vegetation in shoreland areas provides shade, pollution filtering, food for aquatic organisms, and bank stability.

MATERIALS

Native lakeshore species can be collected from an approved site or purchased from a local plant nursery. Live stakes, like other plants, should be planted in areas with suitable soils, moisture and sunlight. See the Planting and Maintaining Vegetation Areas BMP for planting specifications. For a list of native plant nurseries in Vermont visit: www.vtwaterquality.org/wetlands/docs/wl_nativeplants.pdf.

Live Staking Vegetation

Description: Live stakes are living woody plant cuttings capable of quickly rooting in moist soils; generally ½ - 2 inches in diameter and 1-3 feet long and large enough to be tamped-in as stakes. Live staking is most suitable for areas with low to moderate slopes. Since it may take two or more growing seasons for the plantings to become well established, live stakes should be installed in conjunction with temporary erosion control measures such as seeding and mulching.

Purpose: Live stakes make a good, low-cost source of plant materials for stabilizing banks and restoring shoreland (riparian) vegetation. Healthy vegetation in shoreland areas provides shade, pollution filtering, food for aquatic organisms, and bank stability.

Collection. Live stakes can be collected from established/mature plants. This is a cost effective option, but **make sure that permission is granted by property owners** before gathering cuttings off a healthy parent plant. For best results, live stakes should be harvested and planted while the parent plant is dormant in late October

Source: Maine DEP

until the ground is frozen, or in the spring before plants start to leaf-out. Northern counties should aim for spring plantings because the frost heaves plants that are not established. When gathering live stakes, make sure part of the thick end of the branches are at least ½ inch in diameter (the larger the diameter the better).

1. Make a straight cut at the narrow end of the branch (toward the tip of the branch). At the thicker end (toward the trunk) cut the branch at an angle, so that it makes a point. This way you will know which end is up and it will also be easier to drive the stakes into the ground. If the wrong end of the branch is put in the ground the stake will die.
2. Once a cut has been made, remove all side branches and leaves. This will help prevent the stakes from drying. Keep the cut slender side branches, or whips, intact. These whips can be used in the installation process.

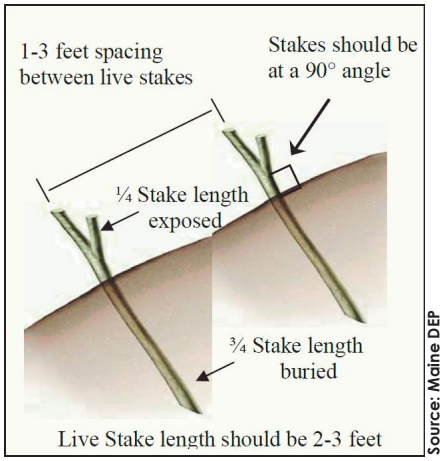
VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Live Staking Vegetation

Bank stabilization

3. To increase the survival rate of the stakes, it is best to plant within 24 hours of collection. Until the planting, keep the stakes damp by wrapping them in wet burlap sacks or soaking them in buckets of water. If the stakes are being planted on a hot day, make sure to store them in the shade.

Purchase. Local nurseries may carry live stakes. When purchasing live stakes, ensure that the plant species are native to Vermont.



Source: Maine DEP

1. The site should be prepared before planting the live stakes. Invasive and competing vegetation should be cut back avoiding the use of herbicides to protect water quality. Information on invasive species can be found at http://www.vtinvasives.org/plants/impact-invasives.
2. In conjunction with live staking, cover bare soil with annual grasses and hay mulch to hold the soil and help prevent weed establishment until the stakes are established.
3. Push (or use a rubber mallet) to carefully drive the pointed end of each live stake into the stream bank. If the stake doesn't go into the ground easily, use a metal rod to first create a hole the length of the stake.
4. Stakes should be planted at a 90° angle with ¼ of the stake (including a few buds) sticking out of the ground. When planting, leave 1-3 feet spacing between the individual stakes. If the stake will be shaded by surrounding vegetation, use longer stakes and leave one foot sticking above the ground. If a willow stake, in particular, gets too much shade, it will drop its new leaves and die.
5. The side branches, or whips, that were snipped off during the collection process will grow nicely if they are planted in very moist areas at the edges of streams and wetlands. Push them into the ground as far as they will go without breaking.

Maintenance: If live stakes are planted while dormant, shoots (leaves and small branches) should be seen in spring. If live stakes are planted during the growing season, it may take a full year or two to see results. If two or three growing seasons pass without signs of growth, remove the dead stakes and replace with live stakes. Also, be prepared to replant if the area is affected by high water, drought, or ice damage before the stakes are fully established. To increase survival, the live stakes could be watered once a week during their first growing season. If a bank is severely eroded or steep it will need more stabilization than live staking. Contact the Lake Wise Program for more information and guidance.

Common Name	Scientific Name	Sun	Height	Soil Moisture
Redosier Dogwood	*Cornus sericea*	Full Sun, Partial Sun, Shade	6-9'	Wet, Flood Tolerant
Grey Dogwood	*Cornus racemosa*	Full sun, Partial Shade	15'	Moist
Pussy Willow	*Salix discolor*	Full Sun	10-15'	Wet, Flood Tolerant

Source: Maine DEP

Three common shrub species suitable for live staking in Vermont.


Redosier Dogwood

Grey Dogwood


Pussy Willow

Stormwater Detention/Retention Basin Site Inspection Report

Inspection Date: 10/16/02

Subdivision/ Development Name: BROOKSTONE

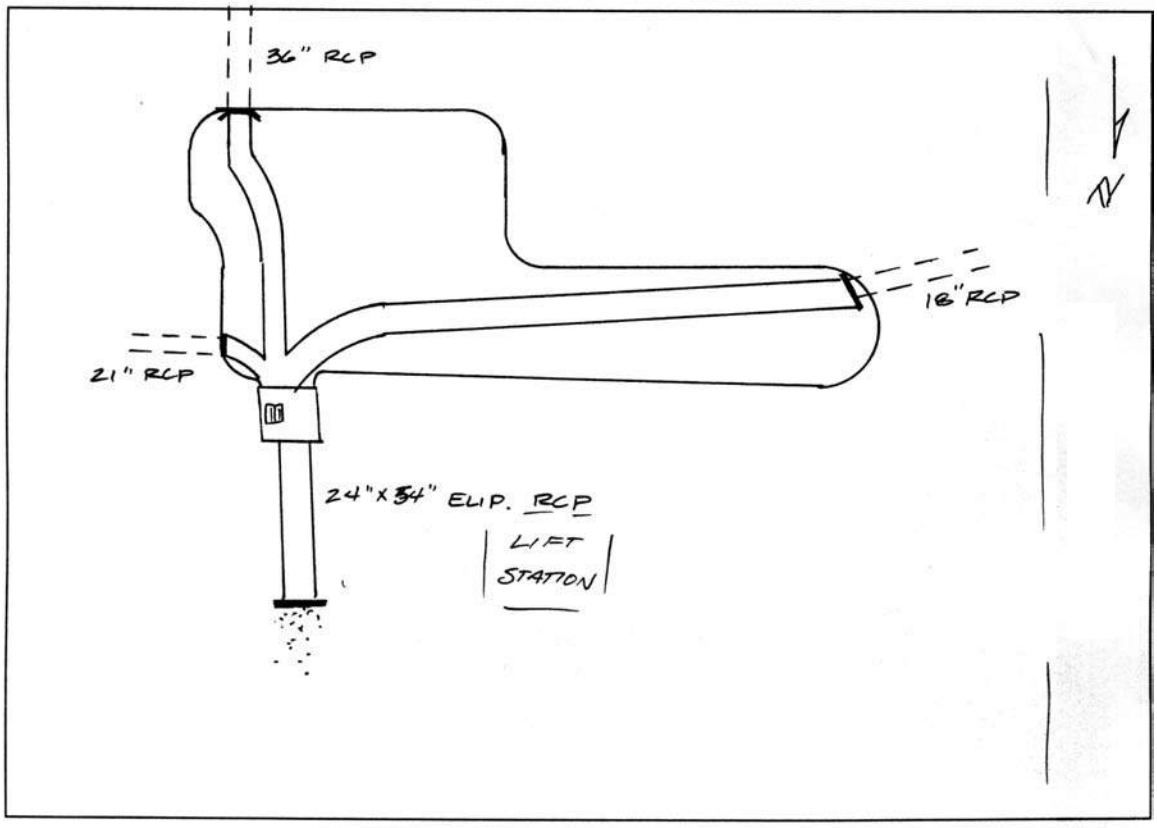
Location: (AT LIFT STATION)

Stormwater Basin Number: 1

Basin Description (check all that apply):

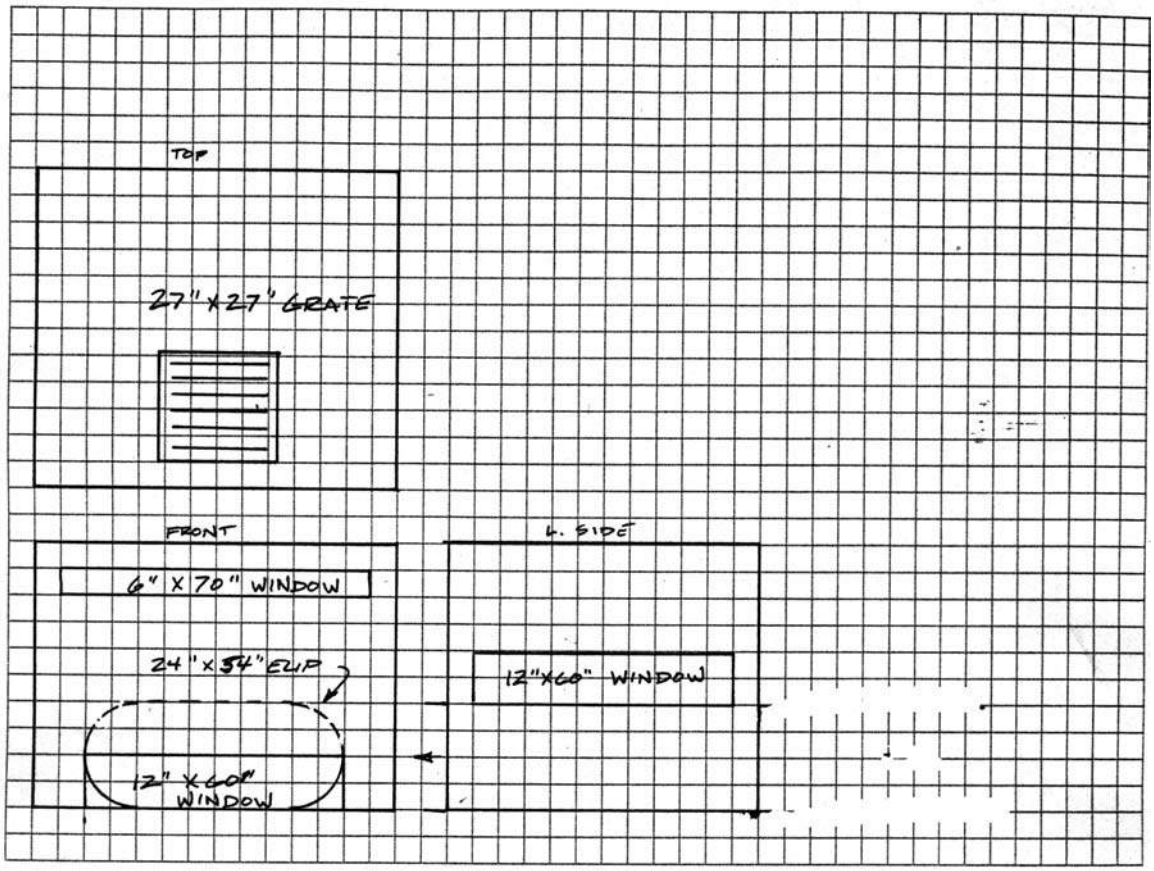
- ☐ Wet Pond
- ☒ Dry Pond
- ☒ Concrete Gutter
- ☐ Outlet Protection
- ☐ Encroachments (fences, landscaping, buildings, etc)
- ☐ Standpipe
- ☐ _____

Sketch of Basin (show inlet pipes, concrete gutter, outlet structure, basin shape, etc):



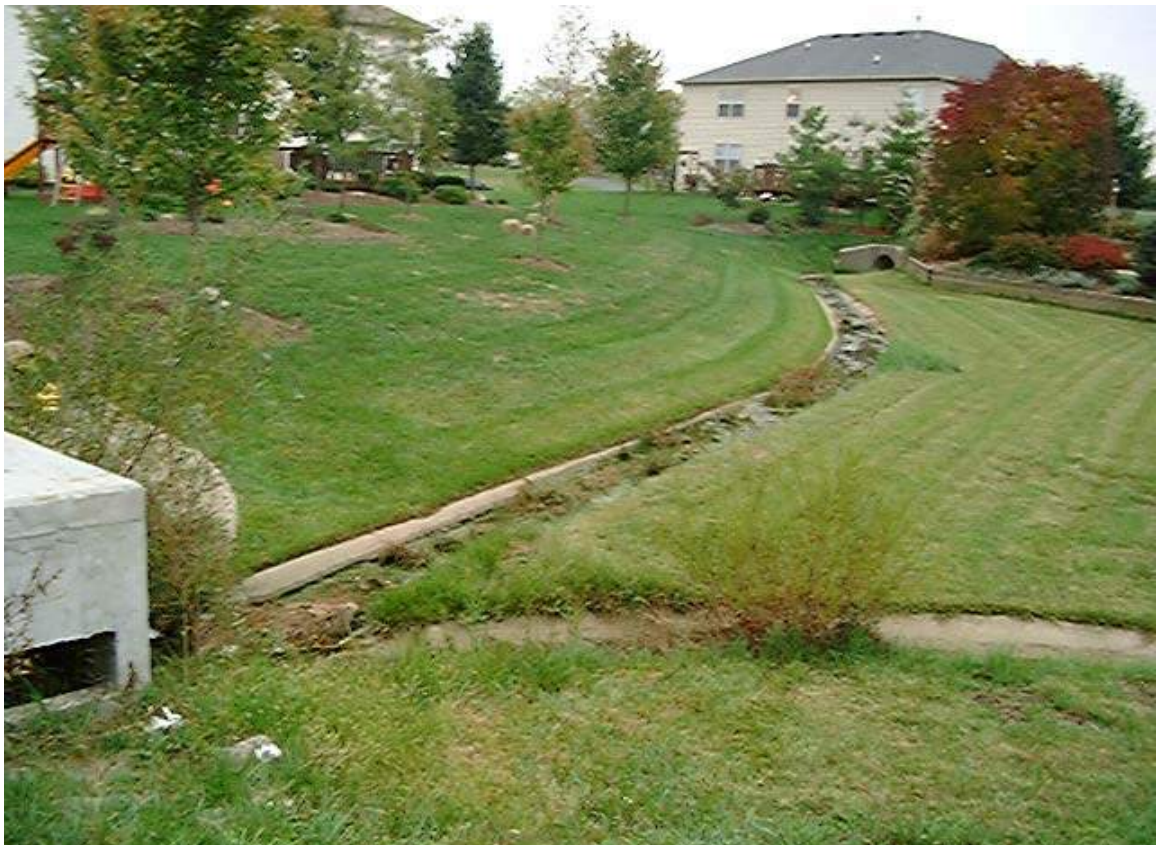
Stormwater Detention/Retention Basin Site Inspection Report

Sketch of Outlet Structure:



Recommended Maintenance (check all that apply):

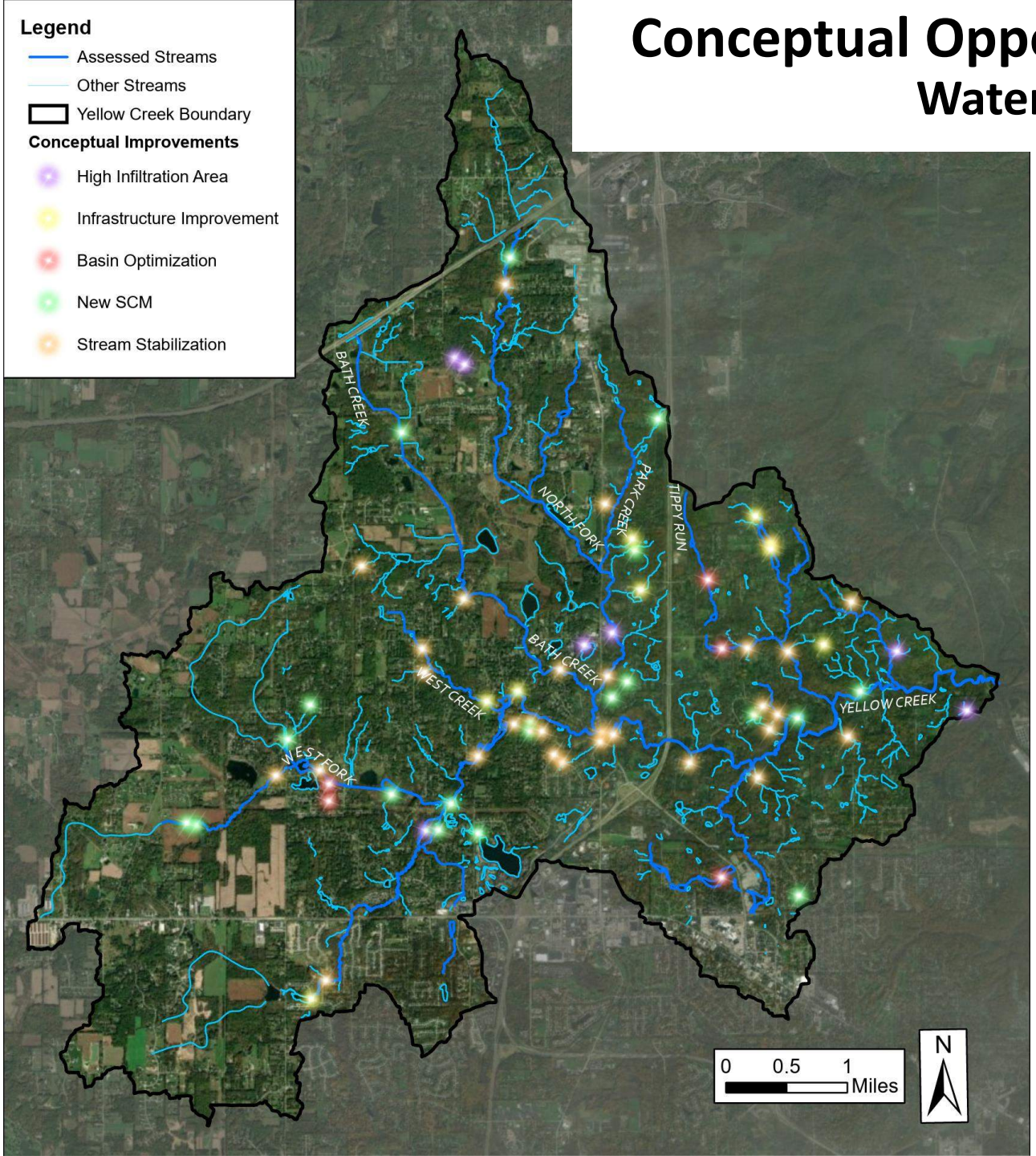
☐	Repair Erosion	☒	Remove Sediment Buildup	☐	Remove Encroachments
☐	Repair Outlet Pipe	☐	Repair Inlet Pipe(s)	☒	Remove Vegetation
☐	Repair Concrete Gutter	☐	Repair Embankment		
☐	AT OUTLET PIPE				



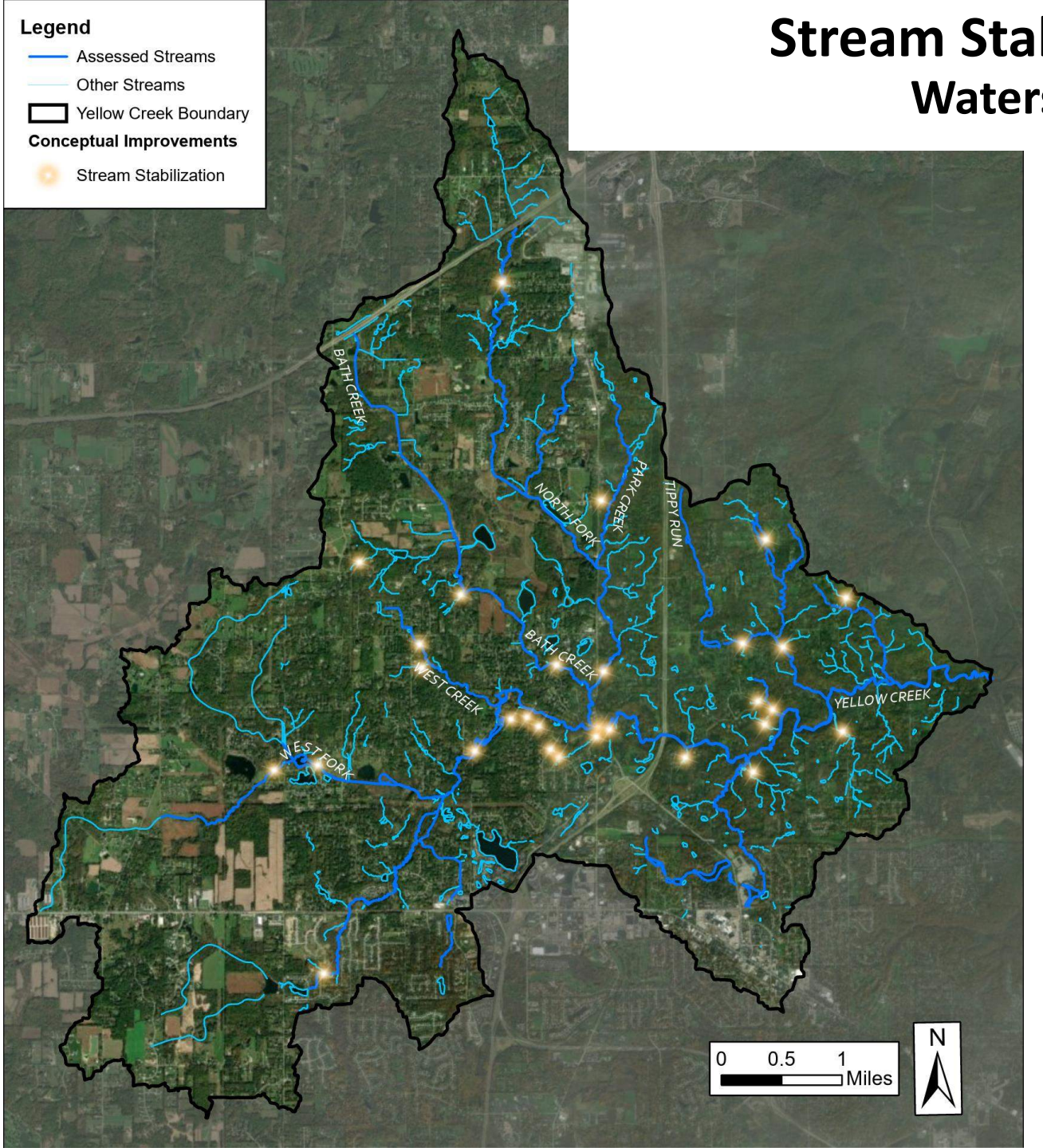
APPENDIX F

Potentially High-Impact Projects

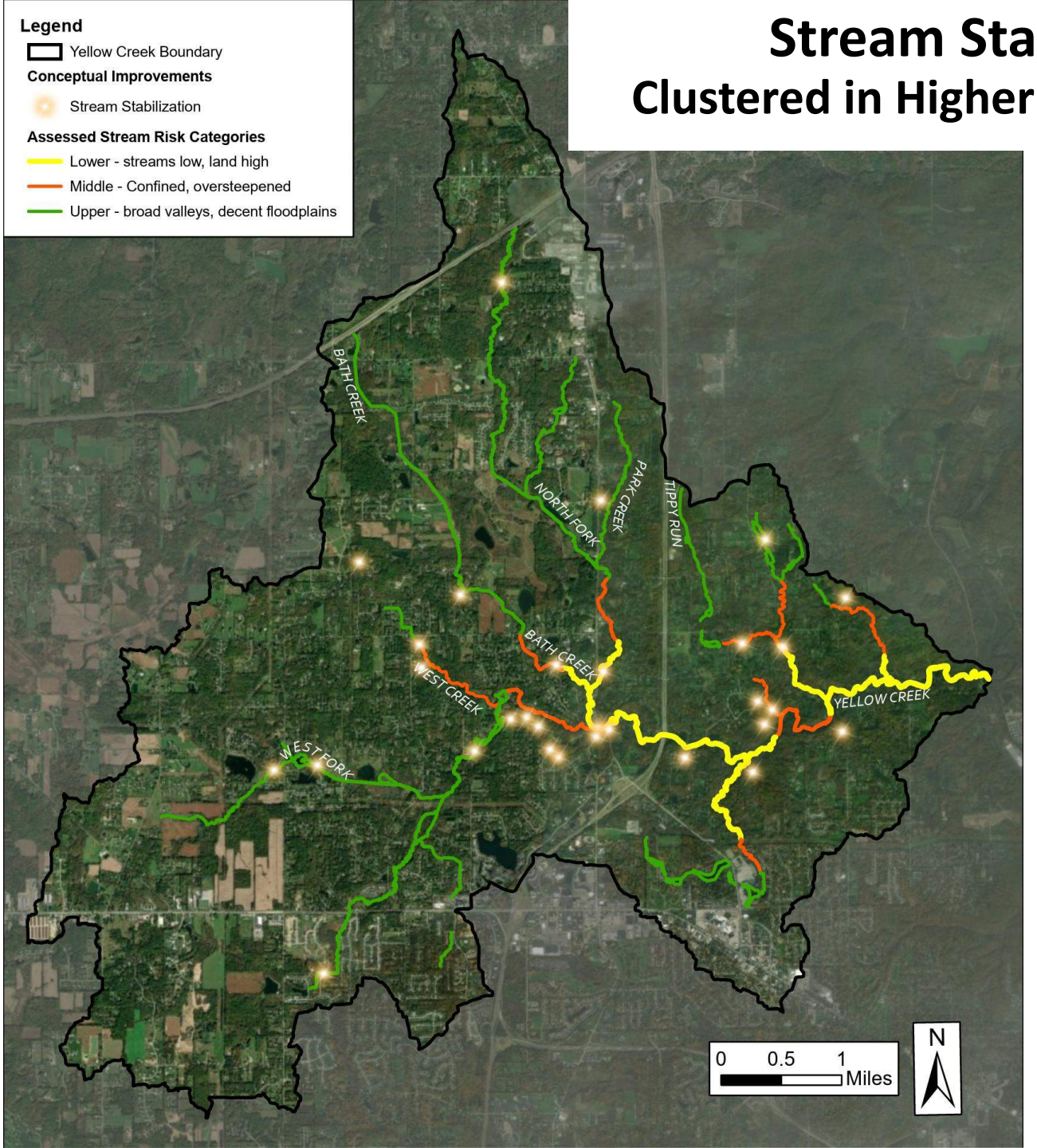
Conceptual Opportunities
Watershed Wide



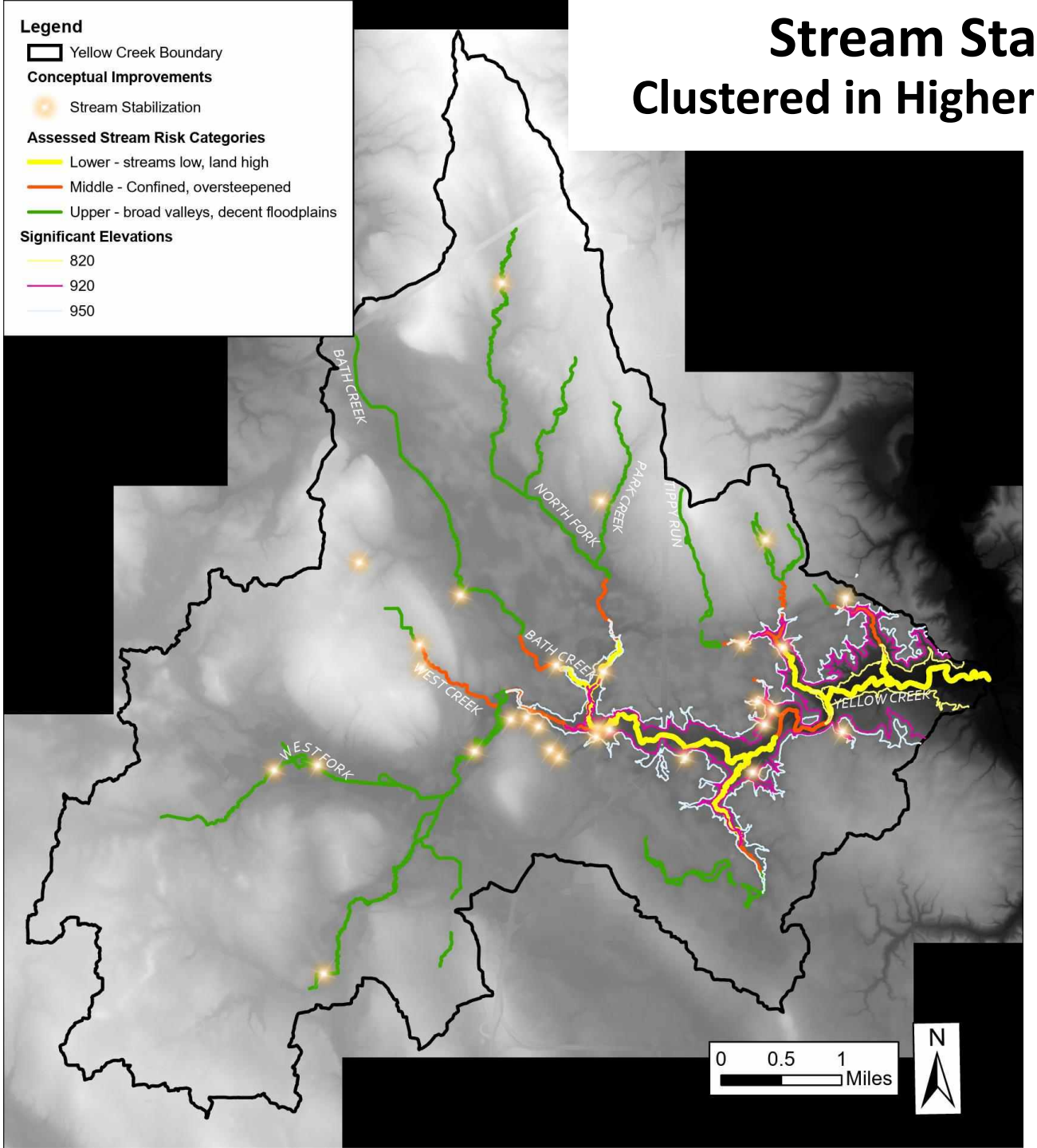
Stream Stabilization
Watershed Wide



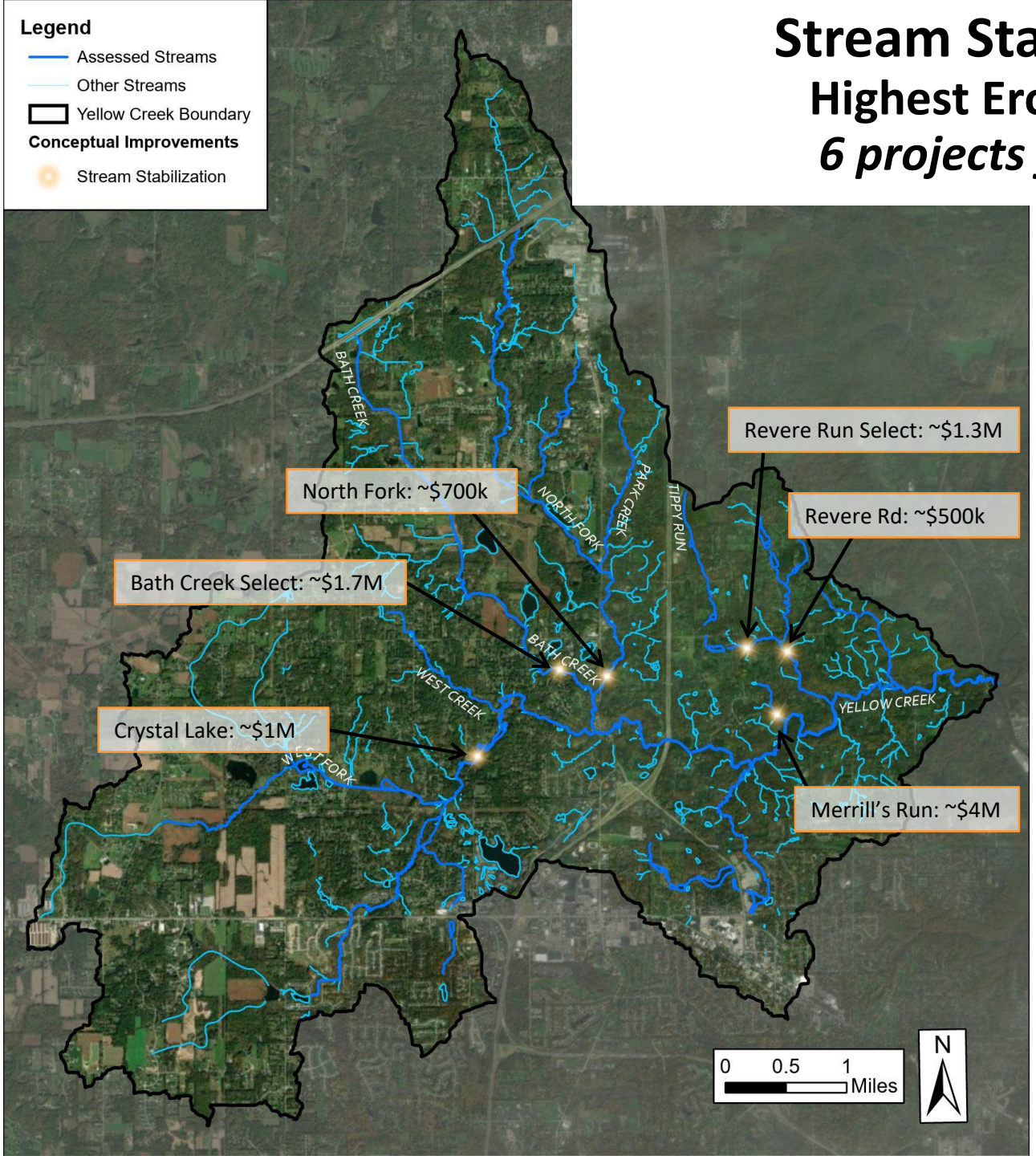
Stream Stabilization
Clustered in Higher Risk Areas



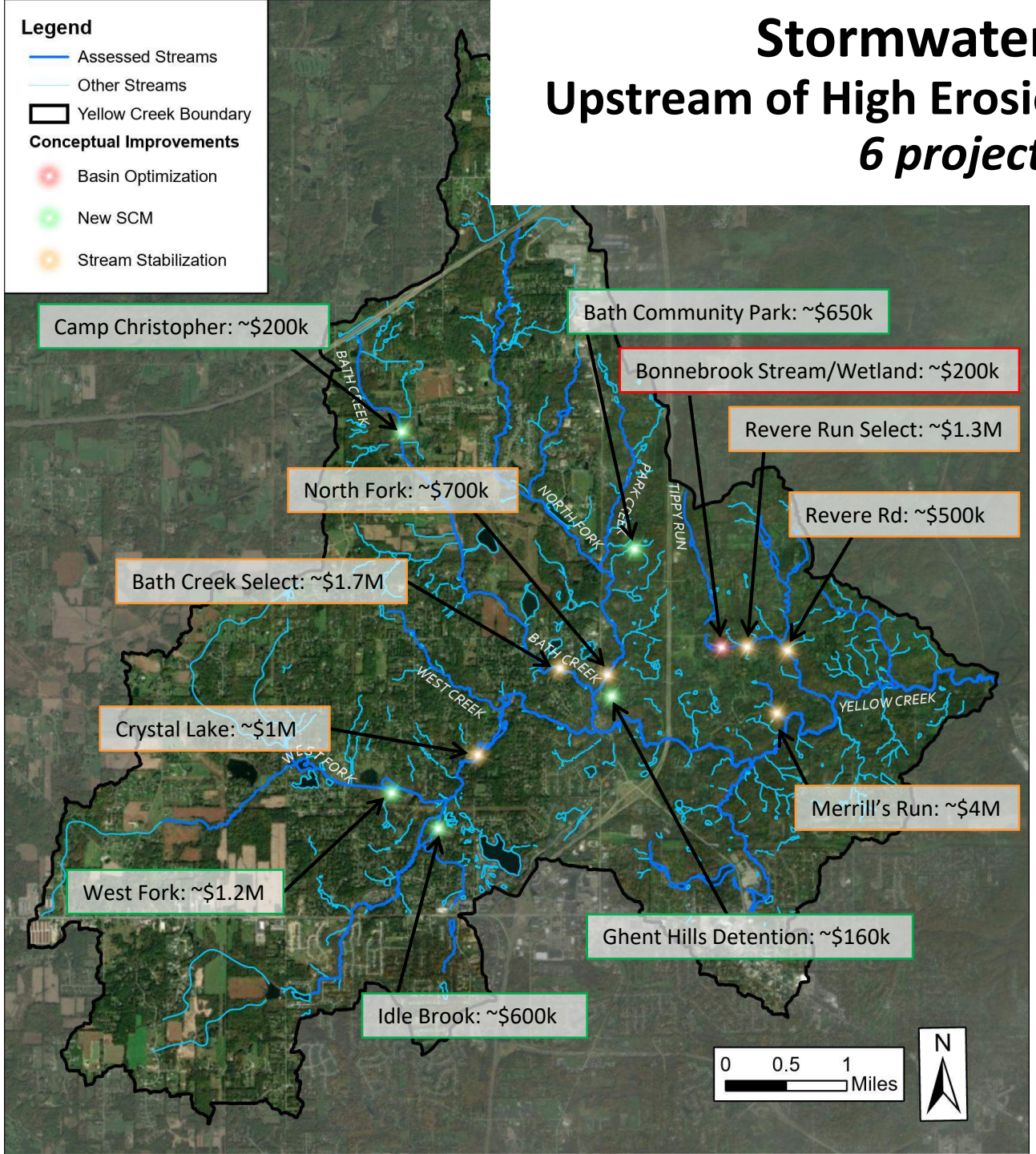
Stream Stabilization
Clustered in Higher Risk Areas



Stream Stabilization
Highest Erosion Areas
6 projects for ~$9.2M



Stormwater Controls
Upstream of High Erosion Streams
6 projects for ~$3M



Stormwater Control Projects*

- **Bonnebrook Dr Stream/Wetland Complete w/ Wet Weather Detention (~$200k)**
  - Surface area of ~2.5 acres & assumed avg. depth of ~4-5 ft, corresponds to ~10-12 ac-ft of new storage
  - Upstream of **Revere Run Select Stream Stabilization concept (~$1.3M)** & **Revere Rd Stabilization (~$500k)**
- **Bath Community Park (~$650k)**
  - Amended swales intercept undetained runoff from parking lot and bankfull wetland in soccer field could potentially create ~7 ac-ft
  - Upstream of **North Fork Stream Re-alignment concept (~$700k)**
- **Camp Christopher Bankfull Wetland (~$200k)**
  - Could create up to ~4 ac-ft of storage in Bath Creek headwaters
  - Upstream of **Bath Creek Select Stream Stabilization concept (~$1.7M)**
- **Ghent Hills Detention (~$160k)**
  - Intercepts ~9 acres of undetained runoff in a ~1 ac-ft detention basin immediately upstream of a ravine with extensive erosion
- **Idle Brook Bankfull Wetland (~$600k)**
  - Could create ~4 ac-ft of highly optimized storage on a public parcel in Idle Brook
  - (*Nester Bankfull wetland is a similar opportunity right downstream but it's not on a public parcel*)
    - Both are upstream of **Crystal Lake Stream Re-alignment ($1M)**
- **West Fork Bankfull Wetland (~$1.2M)**
  - Could create up to ~18 ac-ft of new storage in the headwaters of Yellow Creek
  - Upstream of **Crystal Lake Stream Re-alignment ($1M)**

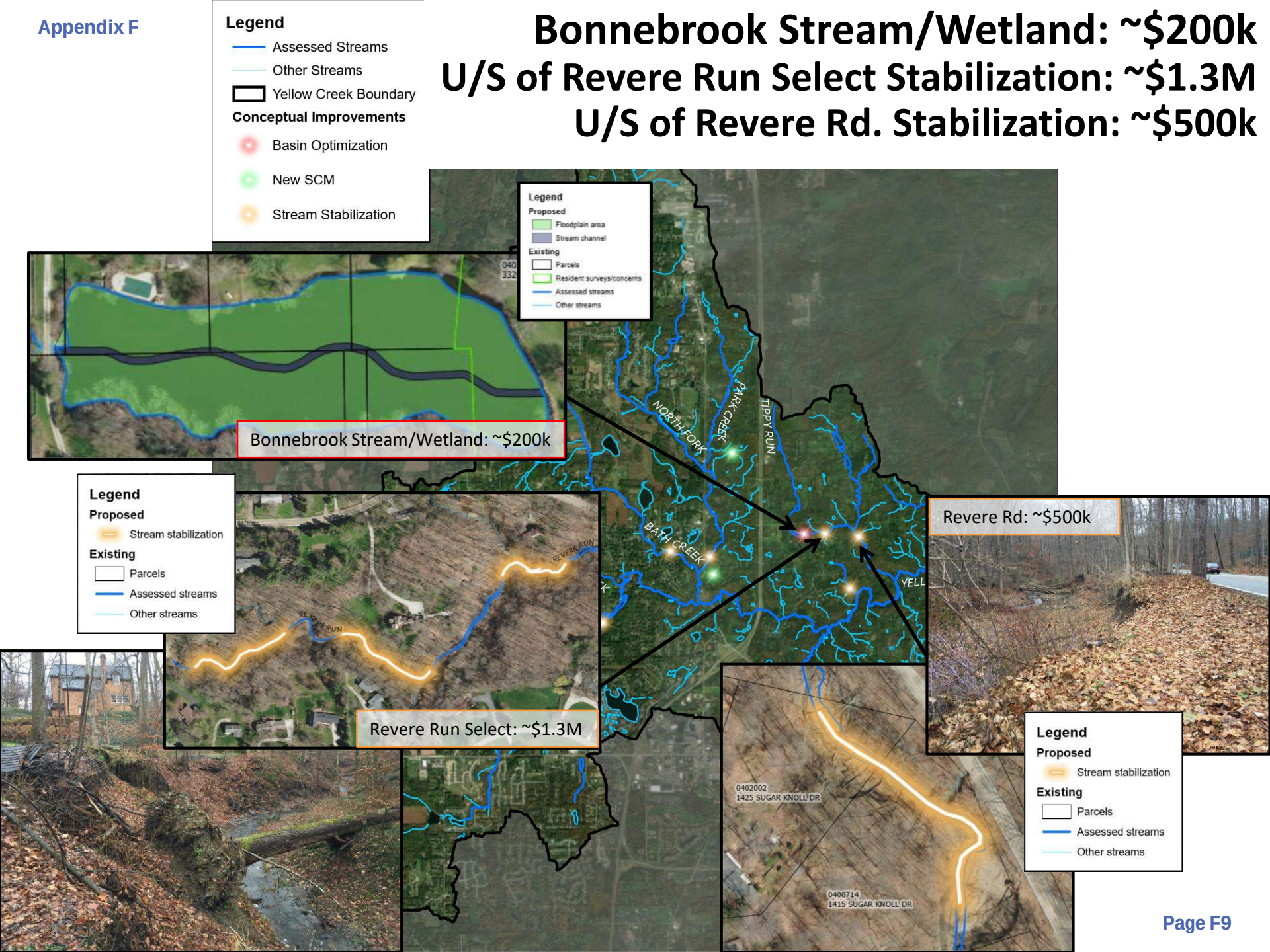
Stream Stabilization Projects*

- **<u>Bath Creek Select Stream Stabilization (~$1.7M)</u>**
  - ~1,400 ft of up to ~45 ft tall banks
  - Downstream of **Camp Christopher Bankfull Wetland (~$200k)**
- **<u>Merrill's Run Stabilization (~$4M)</u>**
  - ~1,500 ft of up to ~60 ft tall banks
- **<u>North Fork Stream Re-alignment (~$700k)</u>**
  - ~550 ft of up to ~60 ft tall banks
  - Downstream of **Bath Community Park (~$650k)**
- **<u>Revere Run Select (~$1.3M)</u>**
  - ~1,100 ft of up to ~65 ft tall banks
  - Downstream of **Bonnebrook Dr Stream/Wetland Complex ($200k)**

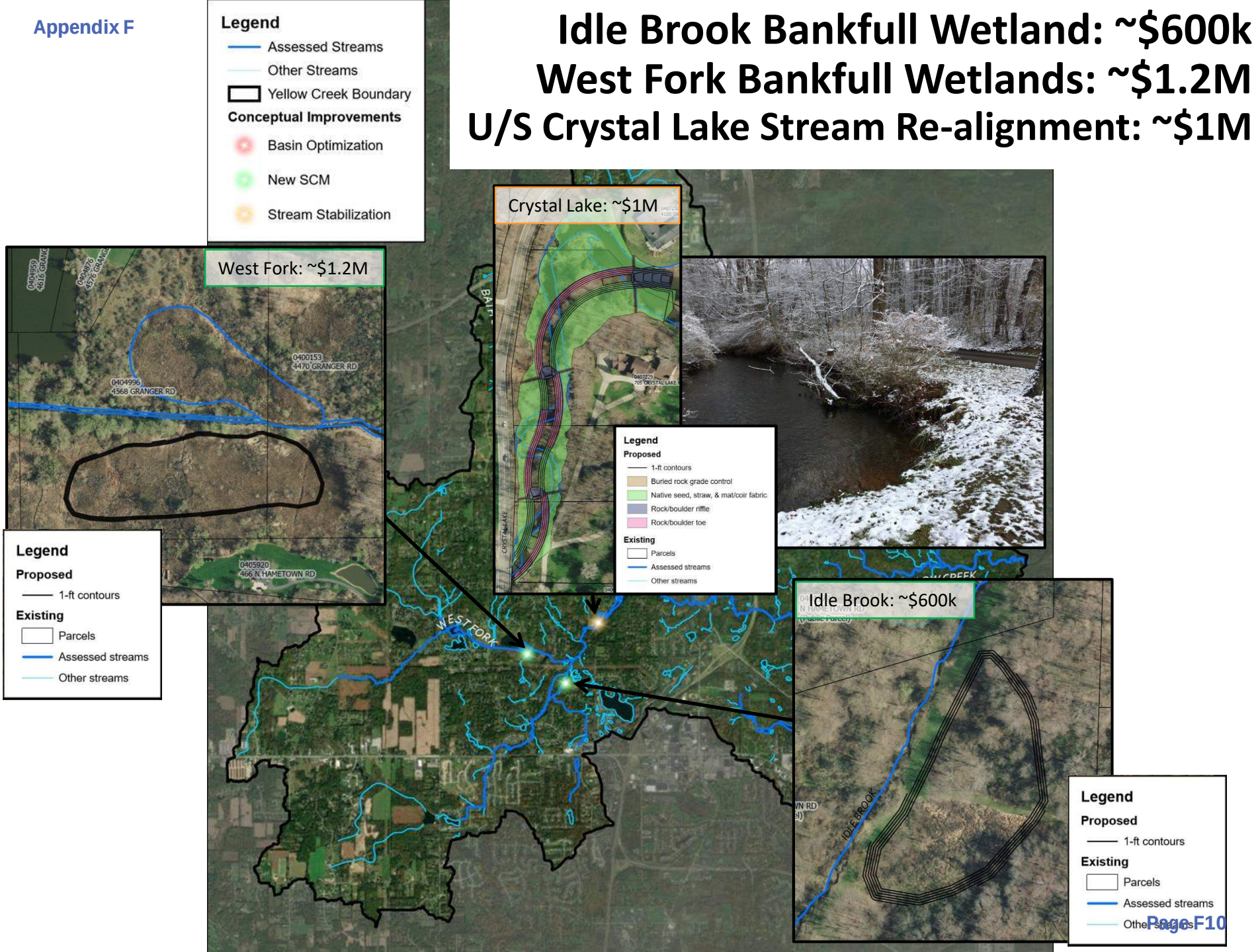
- Above projects (except Merrill's Run) have SCM opportunities upstream.
  - Bonnebrook Dr & Camp Christopher show highest potential for improvements relative to their scale.

* *These lists focus on biggest opportunities for reducing stream erosion. Other factors (infrastructure protection, public safety aspects) can be added to evaluation and affect prioritization.*

Bonnebrook Stream/Wetland: ~$200k
U/S of Revere Run Select Stabilization: ~$1.3M
U/S of Revere Rd. Stabilization: ~$500k



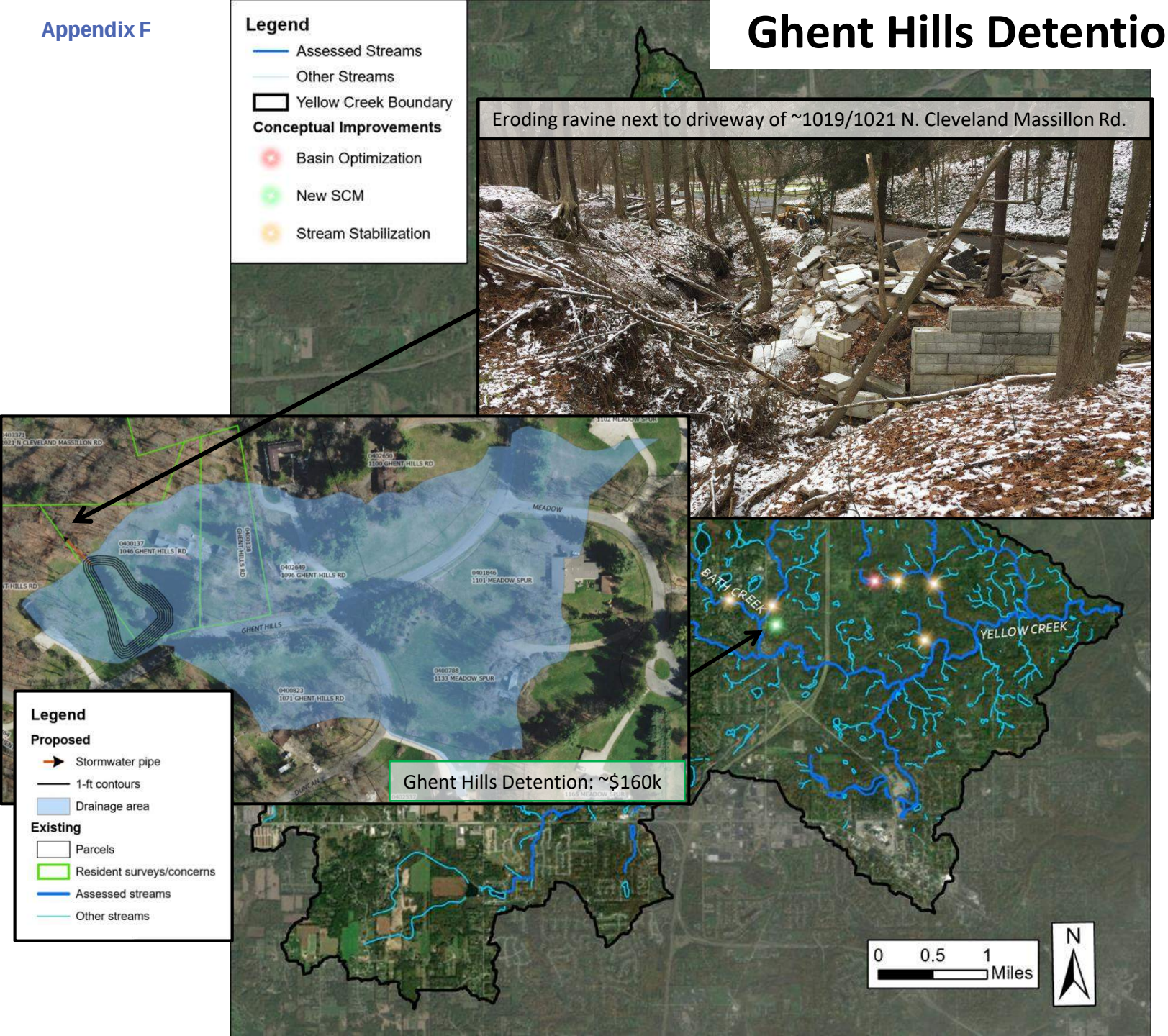
Idle Brook Bankfull Wetland: ~$600k
West Fork Bankfull Wetlands: ~$1.2M
U/S Crystal Lake Stream Re-alignment: ~$1M



Camp Christopher Bankfull Wetland: ~$200k
U/S Bath Creek Select Stream Stabilization :~$1.7M

Bath Community Park Bankfull Wetland: ~$650k
U/S North Fork Stream Re-alignment: ~$700k

Ghent Hills Detention: ~$160k



Merrill's Run Stabilization: ~$4M