Crooked Run, Stony Creek and Pughs Run Stakeholder Meeting

August 19, 2024: Shenandoah County Public Library, Edinburg

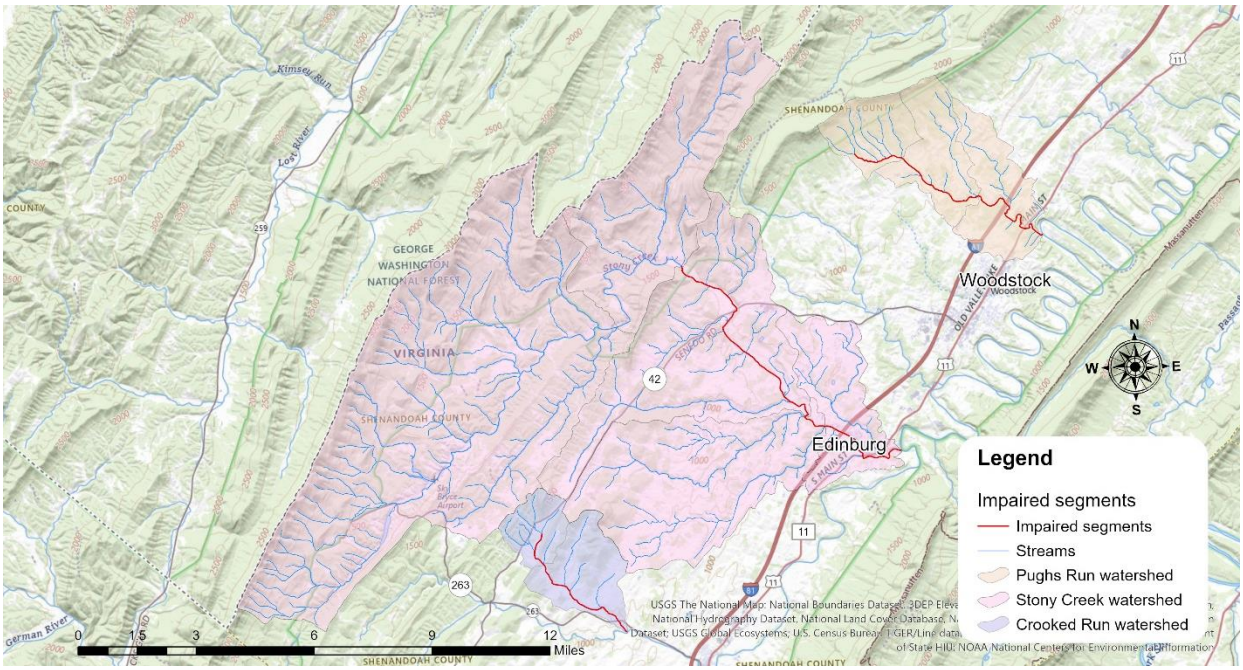

Figure 1. Location of Crooked Run, Stony Creek and Pughs Run watersheds

A Brief Re-Cap

- Crooked Run and two segments of Stony Creek were placed on Virginia's impaired waters list in 2008 and a third segment of Stony Creek was listed as impaired in 2016. Pughs Run was placed on the impaired waters list in 2012
- These streams have impaired benthic macroinvertebrate communities (bugs that live on the bottom of the stream)
- The benthic stressor analysis study indicated that sediment is the cause of impairment in the three streams
- The VA Department of Environmental Quality (DEQ) is working to complete a Total Maximum Daily Load (TMDL) study for the streams. The study will identify sources of sediment in the watersheds. We will develop estimates of how much sediment these sources are contributing, and the reductions needed from those sources to restore the benthic macroinvertebrate community.
- The role of the local community in this process is to review data from the study and provide feedback on sediment sources and reduction scenarios. You can also share information about the watersheds with us including:
    - Historic and current land use and future development
    - Previous and planned restoration projects
    - Local monitoring efforts
    - Key stakeholder groups and contacts

Review of Crooked Run, Stony Creek and Pughs Run Benthic Stressor Analysis

Evidence for sediment as a stressor

- Seasonal trends in benthic health in Crooked Run and Pughs Run indicated poor health in the spring following high spring flows that typically bring greater sediment loads. In Stony Creek where the benthic impairment is more moderate fall SCI scores are greater, though this difference is not significant.
- Taxonomic community structure in the impaired streams indicated shifts to sediment tolerant organisms, and away from those that prefer clean substrate.
- Average Biologic Condition Gradient (BCG) scores for relative bed stability in Crooked and Pughs Runs and Stony Creek were 4.0, 4.0 and 3.9 respectively, suggesting that organisms present in the impaired streams were relatively tolerant of unstable conditions within the stream channel and excess sediment deposition.
- In the Crooked Run habitat assessment, scores for all metrics reflecting excess streambank erosion and sediment deposition were lower than the reference stream. Habitat monitoring results in Crooked Run are also indicative of unstable conditions in the stream channel resulting in a high degree of sediment deposition. Differences were less pronounced in Pughs Run and Stony Creek comparisons. Habitat measurements in Pughs Run largely fell just above or below the optimal range with the exception of embeddedness, riparian vegetation and sediment which were in the middle of the suboptimal range. Riparian vegetation and streambanks measurements in Stony Creek fell within the suboptimal range.
- Comparisons of bottom substrate with reference conditions showed shifts towards sand and fines in the impaired streams, which were most pronounced in Crooked Run. Embeddedness was also greater in both Crooked Run and Stony Creek compared with the reference conditions.
- Visual evidence of incised stream channels, steep and unstable streambanks are all indicative of a sediment stressor.

Accounting for sediment sources in the watersheds

In order to take advantage of monitoring data within the impaired watersheds and develop more refined estimates of sediment loads from sources in the watersheds, they were divided into a series of smaller subwatersheds (two in Crooked Run, three in Pughs Run and five in Stony Creek). Land cover data from the Virginia Geographic Information Network (VGIN, 2016) was then used to estimate acres of the various land cover categories in each subwatershed (**Figure 2, Table 1**). Estimated sediment loading rates could then be applied to each land cover category to estimate the amount of sediment originating from that land cover category in each subwatershed (**Tables 2 through 4, Figure 3**).

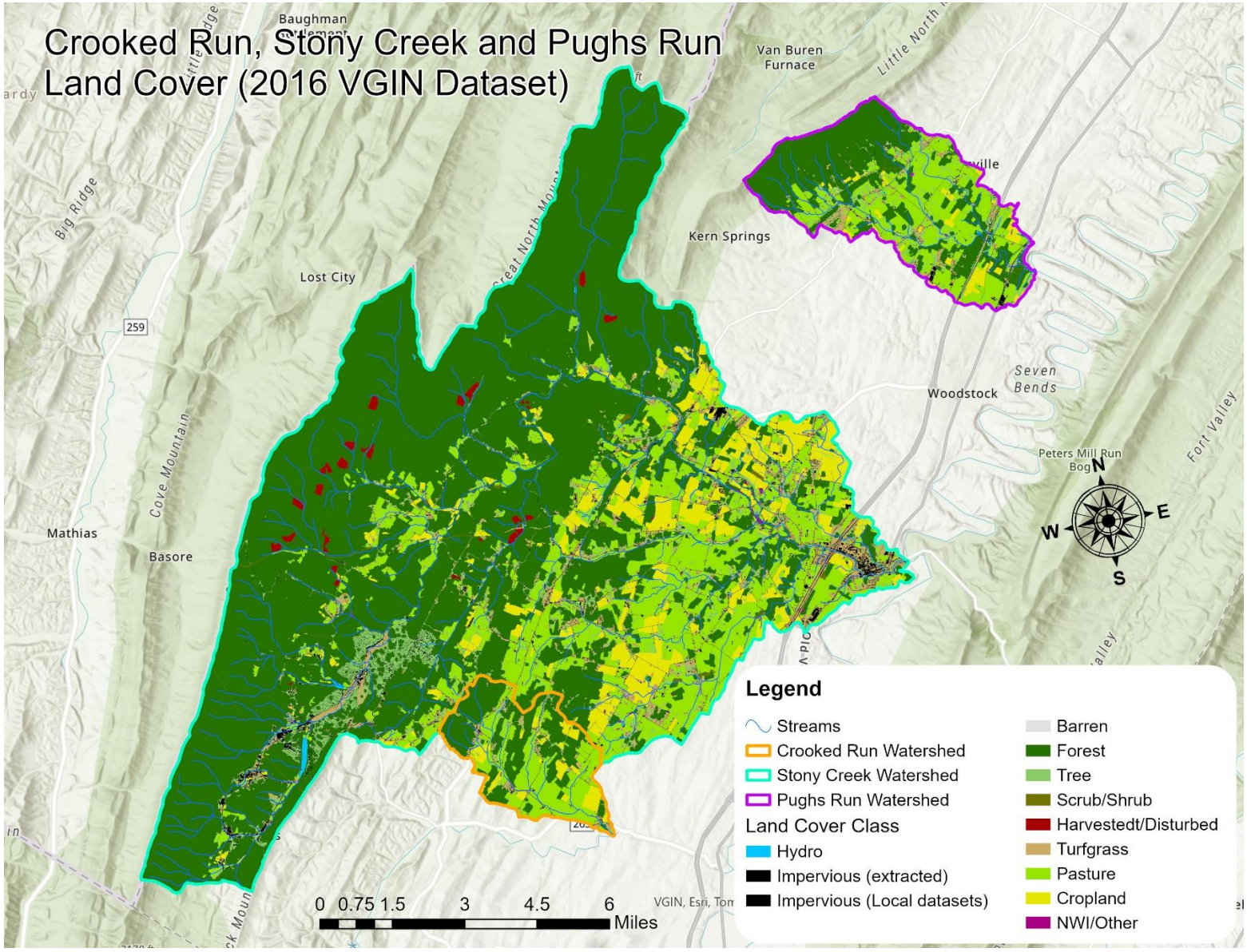

Figure 2. Crooked Run, Stony Creek and Pughs Run Watershed Land Cover Distribution Map

Table 1. Crooked Run, Stony Creek and Pughs Run Watershed Land Cover Distributions

Land Use	**Crooked Run**		**Stony Creek**		**Pughs Run**	
	Acres	*Percentage*	*Acres*	*Percentage*	*Acres*	*Percentage*
Hi till cropland	158	3.68%	1,701	2.36%	157	1.82%
Low till cropland	249	5.80%	2,680	3.71%	248	2.87%
Pasture good	666	15.53%	4,100	5.68%	300	3.48%
Pasture fair	1	0.03%	126	0.17%	948	10.99%
Pasture poor	111	2.59%	301	0.42%	9	0.10%
Animal feeding operations	2	0.05%	6	0.01%	3	0.03%
Hay	773	18.03%	7,049	9.77%	1,626	18.85%
Forest	1,831	42.72%	48,166	66.74%	3,869	44.84%
Harvested forest	0	0%	397	0.55%	0	0%
Barren	0	0%	1	0.00%	0	0%
Developed, pervious	190	4.44%	2,161	2.99%	365	4.23%
Developed, impervious	120	2.79%	1,894	2.62%	290	3.36%
Trees	185	4.33%	3,584	4.97%	812	9.41%
Total	4,285	100%	72,166	100%	8,628	100%

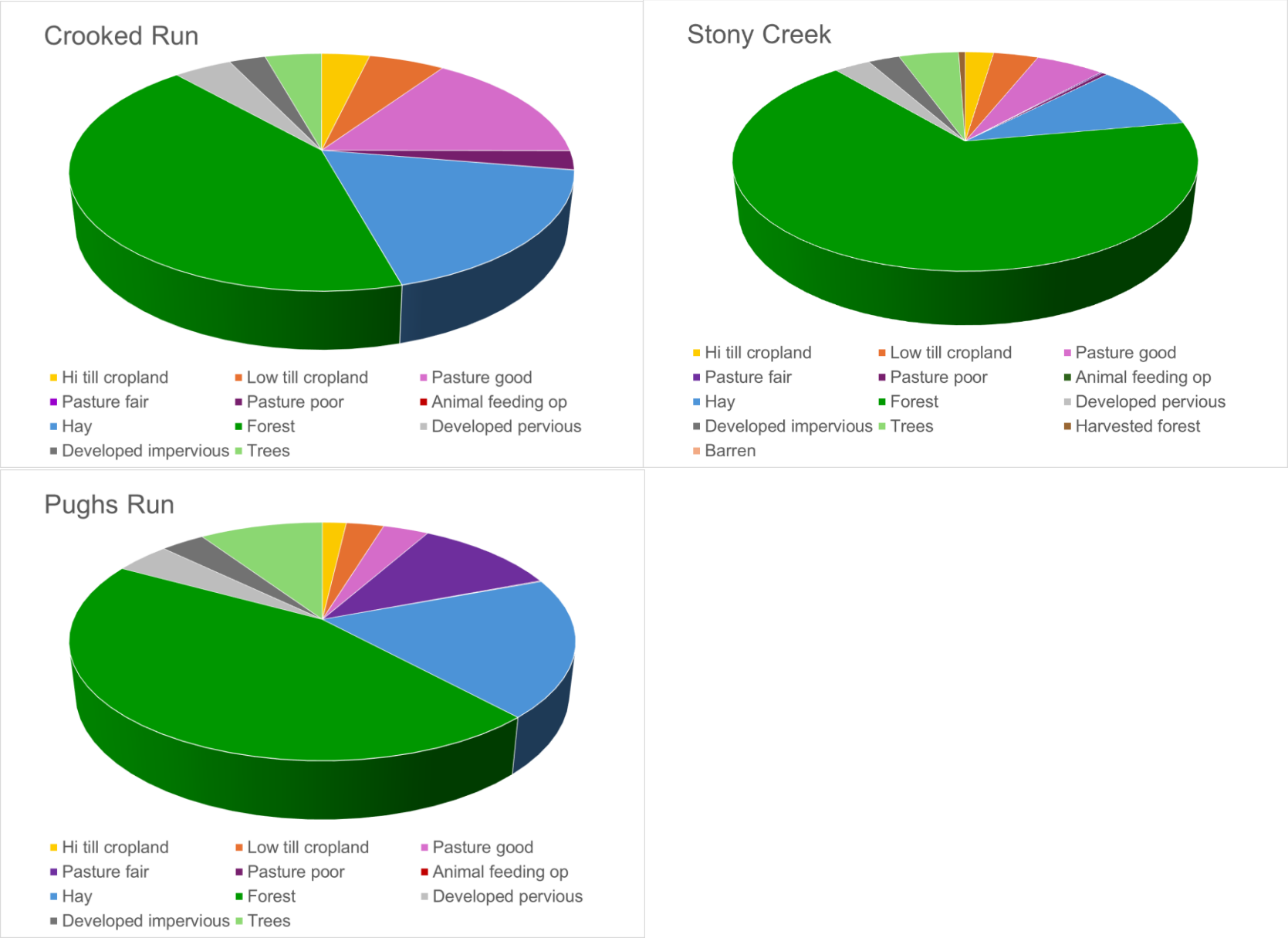

Figure 3. Crooked Run, Stony Creek and Pughs Run Watershed Land Cover Distributions

Table 2. Crooked Run Existing Non Point Source (NPS) Sediment Loads

Crooked Run Existing NPS Sediment Loads			
Land Cover Category	***Area or Length (ac or m)***	***TSS (tons/ac/yr or tons/m/yr)***	***TSS (tons/yr)***
Hi till cropland	158	1.02	160.45
Low till cropland	249	0.28	70.25
Pasture good	666	0.02	15.36
Pasture fair	1	0.27	0.27
Pasture poor	111	0.41	45.19
Animal feeding operations	2	1.89	3.77
Hay	773	0.12	95.39
Forest	1,831	0.01	26.51
Harvested forest	0	-	-
Barren	0	-	-
Developed, pervious	190	0.15	28.65
Developed, impervious	120	0.10	11.70
Trees	185	0.07	12.50
Streambank	9,313	0.0007	6.81
Total NPS Load	-	-	*476.85*

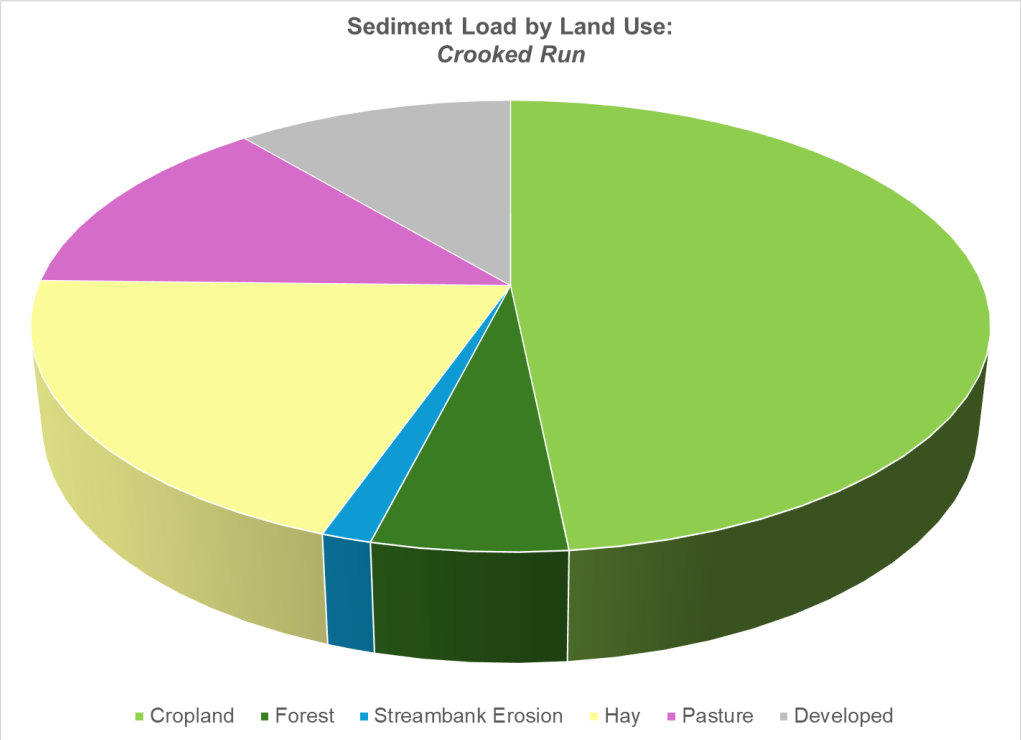

Figure 4. Crooked Run existing non point source sediment loads

Table 3. Stony Creek Existing Non Point Source (NPS) Sediment Loads

Stony Creek Existing NPS Sediment Loads			
Land Cover Category	***Area or Length (ac or m)***	***TSS (tons/ac/yr or tons/m/yr)***	***TSS (tons/yr)***
Hi till cropland	1,701	0.47	805.19
Low till cropland	2,680	0.14	372.75
Pasture good	4,100	0.04	167.73
Pasture fair	126	0.33	41.89
Pasture poor	301	0.73	219.57
Animal feeding operations	6	0.74	4.46
Hay	7,049	0.06	428.90
Forest	48,166	0.01	457.76
Harvested forest	397	0.12	49.19
Barren	1	11.58	11.58
Developed, pervious	2,161	0.08	167.10
Developed, impervious	1,894	0.11	214.55
Trees	3,584	0.05	161.71
Streambank	211,850	0.01	1,969.90
Total NPS Load	-	-	*5,072.29*

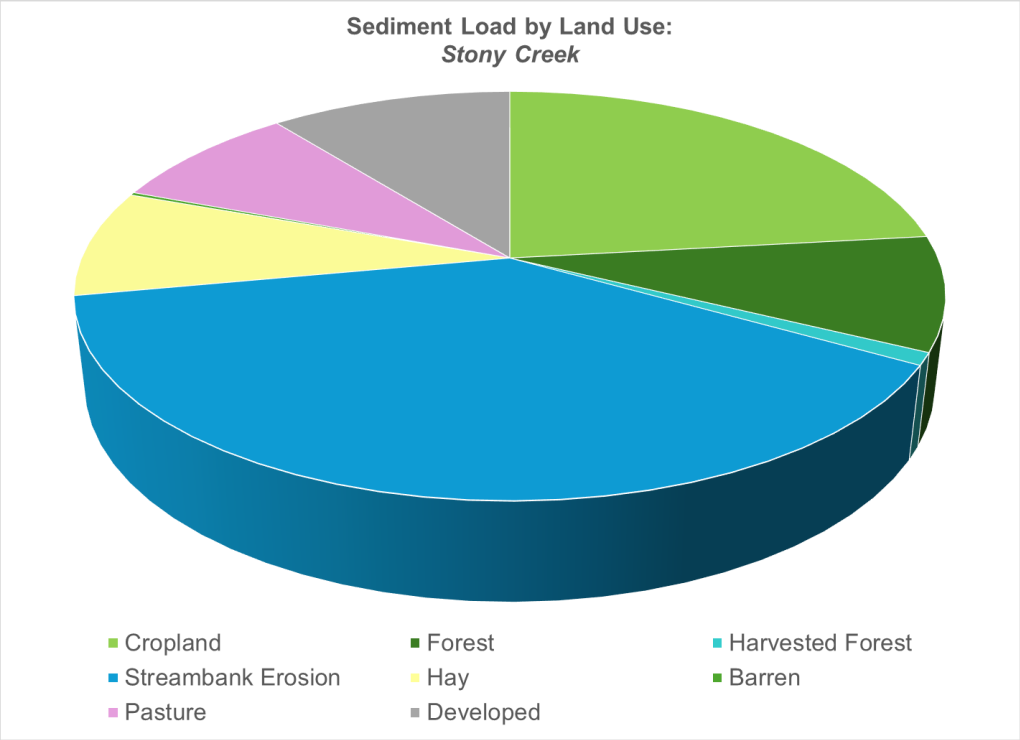

Figure 5. Stony Creek existing non point source sediment loads

Table 4. Pughs Run Existing Non Point Source (NPS) Sediment Loads

Pughs Run Existing NPS Sediment Loads			
Land Cover Category	***Area or Length (ac or m)***	***TSS (tons/ac/yr or tons/m/yr)***	***TSS (tons/yr)***
Hi till cropland	157	0.70	110.67
Low till cropland	248	0.21	51.39
Pasture good	300	0.07	20.04
Pasture fair	948	0.06	54.33
Pasture poor	9	0.12	1.12
Animal feeding operations	3	1.60	4.81
Hay	1,626	0.11	180.90
Forest	3,869	0.01	56.69
Harvested forest	0	-	-
Barren	0	-	-
Developed, pervious	365	0.11	38.73
Developed, impervious	290	0.10	28.42
Trees	812	0.05	39.90
Streambank	14,469	0.003	39.39
Total NPS Load	-	-	626.39

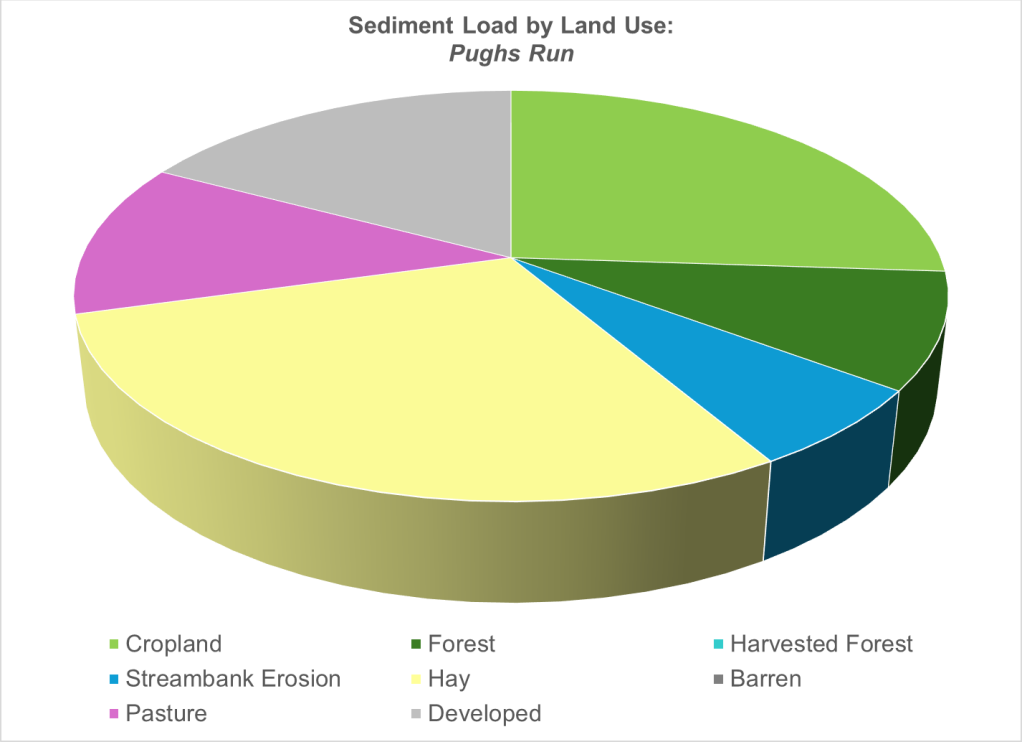

Figure 6. Pughs Run existing non point source sediment loads

Permitted sediment sources

Single Family Home (Domestic sewage) General Permits

There is a total of 45 single family home general permits active within the project area (**Table 5**). These facilities have an estimated discharge of 1,000 gpd with a maximum discharge concentration of 30 mg/L total suspended solids (TSS).

Table 5. Single family home (SFH) general permits in the Crooked Run, Stony Creek and Pughs Run watersheds.

Watershed	Number of SFH permits	Sediment load (lbs/yr)
Crooked Run	2	183
Stony Creek	37	3,381
Pughs Run	6	548

Stormwater Industrial General Permits

There is one stormwater industrial permit (ISW) in the project area, which is located in the Stony Creek watershed (**Table 6**).

Table 6. Stormwater industrial (ISW) general permits in the Crooked Run, Stony Creek and Pughs Run watersheds.

Watershed	Permit number	Facility name	Sediment load (lbs/yr)
Stony Creek	VAR052460	George's Chicken LLC	9,033

Potable Water Treatment Plant General Permits

There is one potable water treatment plant (PWTP) general permit in the project area, which is located in the Stony Creek watershed (**Table 7**). This facility has an average total suspended solids (TSS) limit of 30 mg/L, a design flow of 0.016 MGD, and an average flow of 0.007 MGD.

Table 7. Potable Water Treatment Plant (PTWP) general permits in the Crooked Run, Stony Creek and Pughs Run watersheds.

Watershed	Permit number	Facility name	Existing sediment load (lbs/yr)	Permitted sediment load (lbs/yr)
Stony Creek	VAG640090	Edinburg Water Treatment Plant	640	1,462

Construction Permits

Sediment loads from development were estimated by reviewing construction sites covered under a Virginia Stormwater Management Program (VSMP) permit over a 10 year window of time. This allows us to develop an estimated annual average acreage that is under construction (**Table 8**). There have been no

permits issued for construction in the Crooked Run watershed through this program within the past 10 years. Therefore, an area adjustment factor was applied to the average disturbed area in Stony Creek and Pughs Run to develop an annual estimate for Crooked Run.

Table 8. Active Construction General Permits (CGP) in the Crooked Run, Stony Creek and Pughs Run watersheds between 2013 and 2023.

Watershed	Active permits (#)	Total disturbed area (ac)	Average Area Disturbed Annually (ac)
Crooked Run	0	0	1.1*
Stony Creek	3	51.2	7.2
Pughs Run	1	3.8	3.8

** Estimated value based on area adjusted average area disturbed on Stony Creek and Pughs Run*

Individual VPDES Permits

There are three (3) Individual VA Pollution Discharge Elimination System (VPDES) permits in the project area, all within the Stony Creek watershed (**Table 9**).

Table 9. Individual VPDES permits in the Crooked Run, Stony Creek and Pughs Run watersheds.

Watershed	Permit no.	Facility Name	Existing sediment load (lbs/yr)	Permitted sediment load (lbs/yr)
Stony Creek	VA0020508	Edinburg STP	874	15,992
Stony Creek	VA0028380	Stoney Creek Sanitary District STP	1,936	54,829
Stony Creek	VA0077402	George's Chicken LLC	62,674	103,566

Setting sediment reduction targets

A key component of the TMDL study for Crooked Run, Stony Creek and Pughs Run is the establishment of pollutant reduction goals. While Virginia has water quality criteria that regulate the concentration of some pollutants in our waterways, there are no such criteria for sediment. Therefore, an alternative method must be used to determine the water quality targets for sediment in the TMDL study.

The All Forest Load Multiplier (AllForX) Endpoint Approach

The AllForX approach has been used to establish sediment reduction targets in many TMDLs studies completed in Virginia since 2014. AllForX is the ratio of the simulated pollutant load under existing conditions to the pollutant load from an all-forest simulated condition for the same watershed (see illustration in **Figure 7**). In other words, AllForX is an indication of how much higher current sediment loads are above an undeveloped condition.

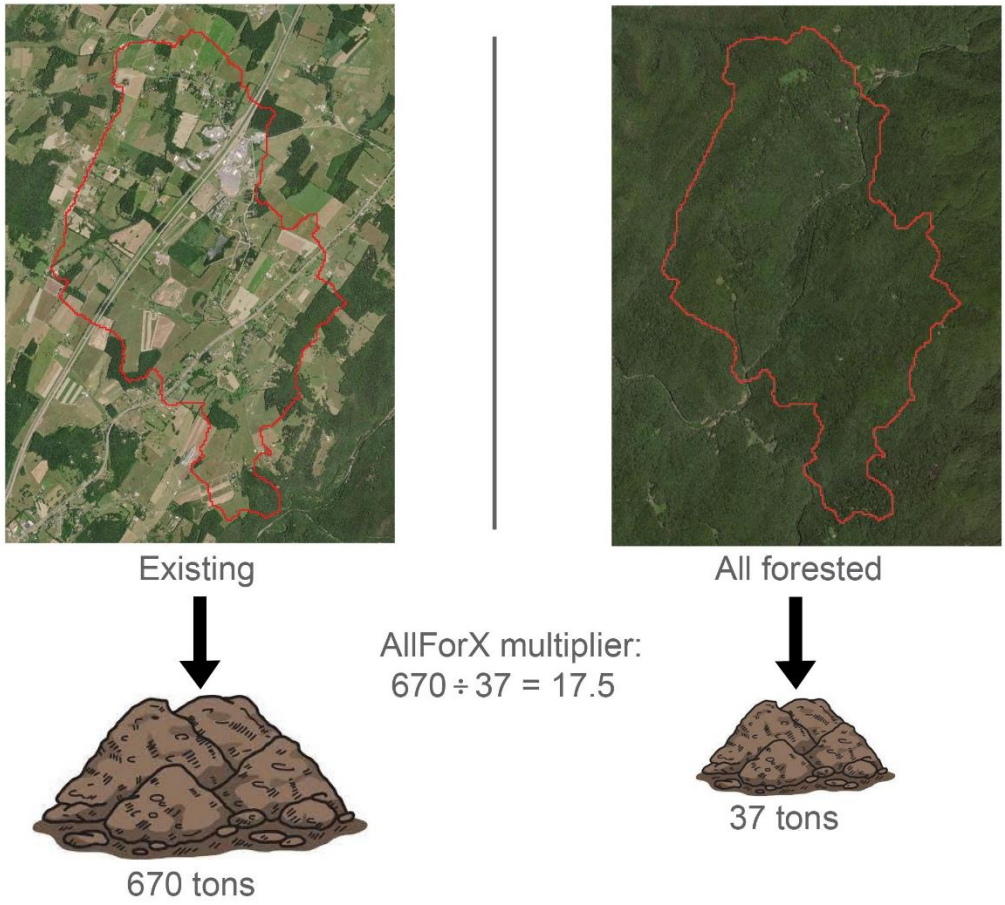

Figure 7. Illustration of Establishment of AllForX Multiplier for a watershed

These multipliers are calculated for the TMDL watersheds as well as a group of unimpaired and impaired comparison watersheds. A regression is then developed between the average Virginia Stream Condition Index (VSCI) scores at each TMDL or comparison monitoring station and the corresponding AllForX ratio for the watersheds contributing to that monitoring site. This regression can be used to quantify the value of AllForX threshold that corresponds to the benthic health threshold (VSCI < 60) as shown in the preliminary regression in **Figure 8**. The pollutant TMDL load can then be calculated by applying the AllForX threshold ratio to the all-forest simulated pollutant load of the TMDL study watershed.

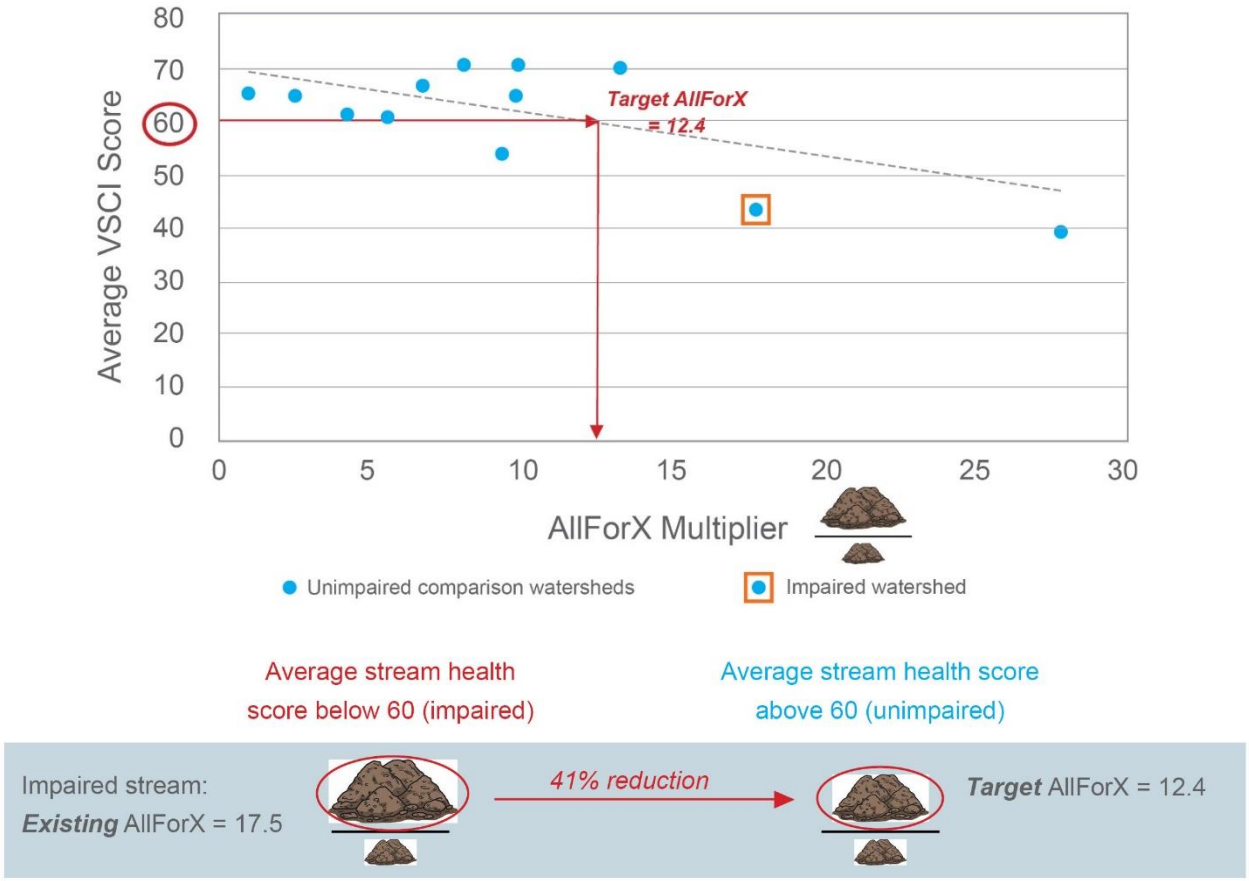

Figure 8. Example of Total Suspended Solids (TSS) AllForX Regression Developed, Resulting in a TSS AllForX Target Ratio of 12.4.

So what does this figure tell us?

If we can reduce the sediment load to the impaired stream by 41%, we will hit the AllForX target ratio of 12.4, which is the point at which average stream health scores typically fall above 60 (the threshold for impairment).

What's next?

Developing Allocation Scenarios

After we determine the total sediment reduction needed in the impaired watersheds by developing AllForX regressions, we will develop a series of allocation scenarios for sediment in the watersheds. The scenarios will identify reductions in sediment needed from different sources (e.g. pasture, turfgrass, urban/suburban land). Stakeholders will be offered an opportunity to review these scenarios and select an option that makes sense for the community.

Contact Information

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