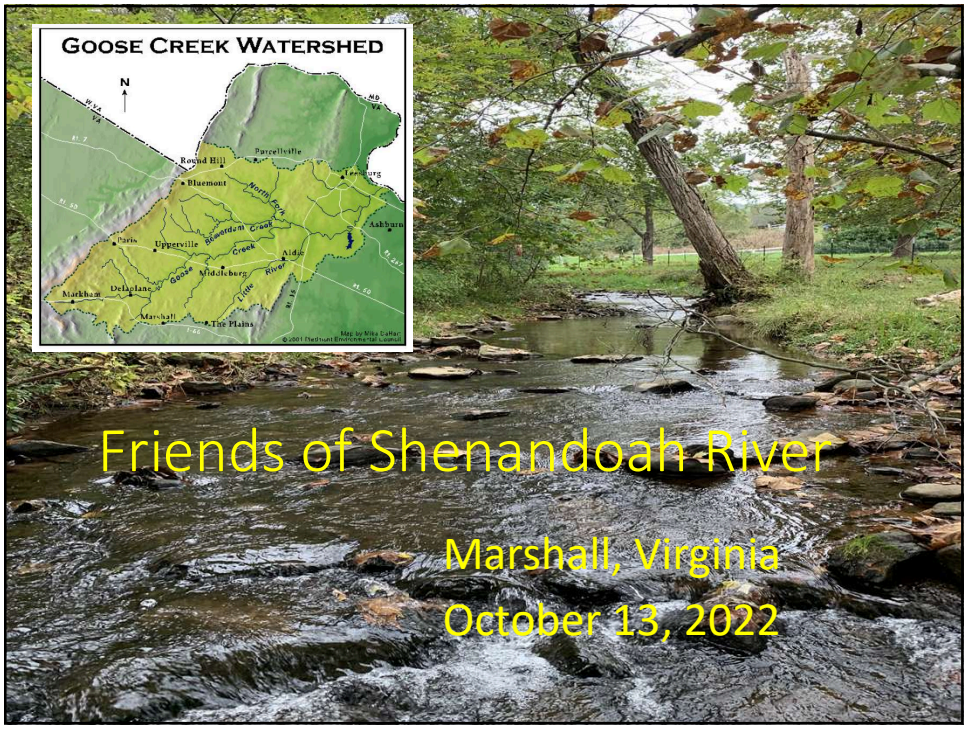


1

Introductions

- Friends of the Shenandoah River (FOSR)
  - Karen Andersen, Laboratory & Program Director
  - Andy Stoddard, Volunteer Consultant
- Goose Creek Association (GCA)
  - Lori Keenan McGuinness, Co-Chair
  - Norman Myers, Board Member
- The Downstream Project
  - Bill Howard, Executive Director

FRIENDS OF THE SHENANDOAH RIVER

GOOSE CREEK ASSOCIATION
CELEBRATING 50 YEARS

THE downstream project

2

Overview of Presentation

- Background
- Clean Water Act
- Goose Creek Watershed & WQ Conditions
- Goose Creek Watch Monitoring Program
- Year 1- Selected Results
- Recommendations for Year 2 and Beyond
- Data Sharing and Water Reporter
- Questions & Discussion

3

Background

A collaboration to protect the waters of Goose Creek and its tributaries through a rigorous, scientifically-grounded water quality monitoring effort

4

Who are Friends of the Shenandoah River?

- Non-profit scientific focused organization
- FOSR maintains and operates an accredited water quality testing lab
- Located on the campus of Shenandoah University in Winchester
- Meets Virginia Department of Environmental Quality's Level III criteria

5

FOSR Field and Laboratory Capability

- Professional laboratory and field operations are carried out by staff and trained citizen-volunteers
- DEQ accredited water quality testing laboratory
- DEQ-approved Quality Assurance/Quality Control Plans (QAPPs) for laboratory and field operations

FOSR
FRIENDS OF THE SHENANDOAH RIVER

FRIENDS OF THE SHENANDOAH RIVER

Volunteer Citizen Scientist Water Monitoring
and
Water Quality Analysis
Quality Assurance Project Plan

For

Long-term Assessment of Water Quality in the Shenandoah River Basin

Friends of the Shenandoah River
Shenandoah University
1460 University Drive
FOSR's Water-quality Testing Laboratory
152 Gregory Hall
Winchester, Virginia 22601

January 2022
(Revision of Version II, August 2012)

6

In situ Field Measurements

- Tasks performed by FOSR's laboratory staff and trained and certified volunteer citizen scientists in the field:
  - Dissolved oxygen (DO)
  - pH
  - Temperature (T•C)
  - Conductivity (µS/cm)
  - Water sample collection
  - Documentation of observations and conditions

FOSR maintains and operates an accredited water quality testing lab that meets the Virginia Department of Environmental Quality's Level III criteria

7

Nutrients

- Nitrate/Nitrite
- Total Nitrogen (TN)
- Ortho Phosphate
- Total Phosphate (TP)
- Ammonia

FOSR maintains and operates an accredited water quality testing lab that meets the Virginia Department of Environmental Quality's Level III criteria

8

Why Do We Test for Nutrients?

Positive

- All living organisms require nutrients
- Necessary for plant growth.
- Plants -reduce CO_2, release oxygen, produce crops that are consumed by people, animals, and other herbivores

Negative

- Eutrophication
- Algal blooms
  - Release of potentially hazards toxins
- Aquatic vegetation
- Decreased oxygen
- Fish Kills

Unnamed tributary feeds into Sleeter Lake

9

Bacteria

- FOSR uses the industry-wide accepted IDEXX Colilert-18® method for the determination of the *E. coli* concentrations.

- **Finding *E. coli* bacteria in water indicates recent fecal contamination & possible presence of other disease-causing microorganisms or pathogens**

- **As level of *E. coli* increases, potential health risk from exposure to pathogenic organisms also increases**

Friends of the Shenandoah River's water quality analysis lab set up for E. coli bacteria testing

FOSR maintains and operates an accredited water quality testing lab that meets the Virginia Department of Environmental Quality's Level III criteria

10

FOSR's Water-quality Testing Lab QA/QC

Run Configuration Tools Window Help

New Open Save Start Preview Stop Run1 Run2 Run3 Run4

Sample No.	Cup No.	Sample ID	Sample Type	Reps	ADF	Trigger OFF	MDF	Weight	Units
1	S1	Amm CalStd 2.0	Unknown	2		☑			
2	80	Nit/OrthoPhos 2.0 PPM	Unknown	1		☑			
3	S3	DI H2O	Unknown	1		☑			
4	85	Nitrite 2.0 ppm	Unknown	1		☑			
5	S1	Ammonia CalStd 2.0	Calibration Standard	2					
6	S1	Ammonia CalStd 0.8	Calibration Standard	2	☑ 2.50				
7	S1	Ammonia CalStd 0.2	Calibration Standard	2	☑ 10.00				
8	S1	Ammonia CalStd 0.05	Calibration Standard	2	☑ 40.00				
9	S1	Ammonia CalStd 0.03008	Calibration Standard	2	☑ 66.50				
10	S1	Ammonia CalStd 0.02	Calibration Standard	2	☑ 100.00				
11	S3	Ammonia CalStd 0.0	Calibration Standard	2					
12	S2	OrthoPhos 2.0/ NO2/NO3 2.0	Calibration Standard	2					
13	S2	OrthoPhos 0.8/ NO2/NO3 0.8	Calibration Standard	2	☑ 2.50				
14	S2	OrthoPhos 0.5/ NO2/NO3 0.5	Calibration Standard	2	☑ 4.00				
15	S2	OrthoPhos 0.2/ NO2/NO3 0.2	Calibration Standard	2	☑ 10.00				
16	S2	OrthoPhos 0.05/ NO2/NO3 0.05	Calibration Standard	2	☑ 40.00				
17	S2	OrthoPhos 0.02/ NO2/NO3 0.02	Calibration Standard	2	☑ 100.00				
18	S2	OrthoPhos 0.01/ NO2/NO3 0.01	Calibration Standard	2					
19	S3	OrthoPhos 0.0/ NO2/NO3 0.0	Calibration Standard	2					
20 Q1	S11	DI H2O	Check Standard	1					
21 Q1	S12	AMM QC	Check Standard	1					
22 Q1	S13	AMM LFB	Check Standard	1					
23 Q1	S14	NIT/ ORTHO PHOS QC	Check Standard	1					
24 Q1	S15	NIT/ ORTHO PHOS LFB	Check Standard	1					
25	1	FLGCLR	Unknown	1					
26	2	FFGCHGC	Unknown	1					
27	3	FLGCPSC	Unknown	1					
28	4	FLGCPSC(2)	Unknown	1					
29	5	FLGCGC	Unknown	1					
30	6	FLGCTC	Unknown	1					
31	7	FLGCTC(2)	Unknown	1					
32	8	FLGCTribSL	Unknown	1					
33	80	Nit/OrthoPhos 2.0 PPM	Unknown	1		☑			
34	S3	DI H2O	Unknown	1		☑			
35	85	Nitrite 2.0 ppm	Unknown	1		☑			
36 Q1	S11	DI H2O	Check Standard	1					
37 Q1	S12	AMM QC	Check Standard	1					
38 Q1	S13	AMM LFB	Check Standard	1					
39 Q1	S14	NIT/ ORTHO PHOS QC	Check Standard	1					
40 Q1	S15	NIT/ ORTHO PHOS LFB	Check Standard	1					

FOSR maintains and operates an accredited water quality testing lab that meets the Virginia Department of Environmental Quality's Level III criteria

11

How Do we Share FOSR Data?

- Data uploaded onto social media platforms
- Data submitted to Virginia DEQ annually
- Data submitted to EPA-USGS Water Quality Portal

Water Quality Monitoring – 2022 IR

- Water quality data was evaluated for multiple parameters collected by DEQ at approximately 3400 stations
- Data from nearly 500 non-agency stations and over 1,650 citizen monitoring stations were submitted for use in the assessment

Citizen-volunteers 1,650 sites to DEQ

2022 IR – Non-agency and Citizen Monitoring

AGU PUBLICATIONS

Water Resources Research

TECHNICAL REPORTS: DATA

10.1002/2016WR019993

Water quality data for national-scale aquatic research: The Water Quality Portal

Emily K. Read[1], Lindsay Carr[1], Laura De Cicco[1], Hilary A. Dugan[2], Paul C. Hanson[2], Julia A. Hart[2], James Kreft[1], Jordan S. Read[1], and Luke A. Winslow[1]

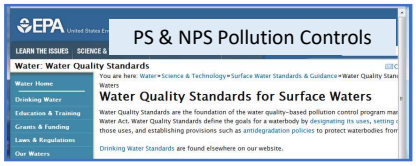
Key Points:
- The Water Quality Portal aggregates and serves more than 297,000,000

12

"Just a ten-minute walk from this Chamber, the Potomac River is a hazard to health. The Georgetown Gap in the District of Columbia's sewer pipelines allows 15 million gallons of raw sewage to pour into the river every day.

Clean Water Act
October 18,1972

Clean Water Act became law in 1972



"Restore & maintain physical, chemical, biological integrity of nation's waters"

"Zero discharge … by 1983"

13

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

CWA
State's Authority

- Set water quality (WQ) standards as legal basis to support designated uses (water supply, recreation, aesthetics etc.)
- Evaluate WQ monitoring data for compliance or violation of standards
- Identify streams as impaired or fully supporting designated uses
- Set permit limits as legal basis for effluent discharge of wastewater & stormwater
- Identify point & nonpoint pollution sources
- Develop Watershed Protection & Clean-up plans (e.g., TMDLs) to achieve compliance
- Develop Implementation Plans
- After implementation of plans, if WQ improvements show compliance with WQ standards, impaired stream can be De-Listed
- **CWA success story!**

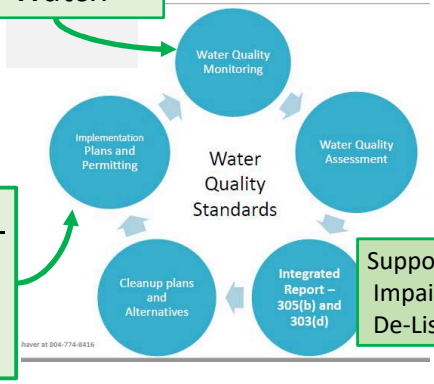
14

CWA Water Quality Management

- Science-based assessment & plans
- Public & private support
- Necessary investment
- Leads to CWA success stories!

GCA & FOSR
Goose Creek Watch

DEQ Continuing Planning Process



Supporting Impaired De-Listed

Goose Creek Association
Tree planting
Riparian buffers
Convert farms to forest

Source:
DEQ 2022 Integrated Report

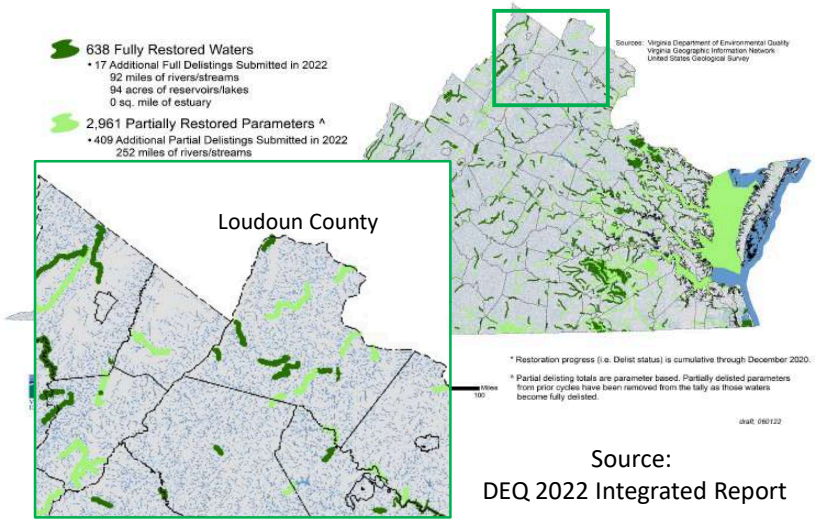
15

WQ Restoration (De-List) Progress

DEQ
Virginia Department of Environmental Quality

638 Fully Restored Waters
• 17 Additional Full Delistings Submitted in 2022
92 miles of rivers/streams
94 acres of reservoirs/lakes
0 sq. mile of estuary

2,961 Partially Restored Parameters ^
• 409 Additional Partial Delistings Submitted in 2022
252 miles of rivers/streams



* Restoration progress (i.e. Delist status) is cumulative through December 2020.
^ Partial delisting totals are parameter based. Partially delisted parameters from prior cycles have been removed from the tally as those waters become fully delisted.

Source:
DEQ 2022 Integrated Report

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Goose Creek Association

- GCA is actively working to help identify and support public-private efforts to improve water quality conditions in Goose Creek watersheds
- GCA goal for Goose Creek stream segments listed as "Impaired" by DEQ
  - Streams De-Listed in future DEQ Integrated Reports
  - Streams in compliance with Water Quality standards
  - Streams Fully-Supporting of Beneficial Uses
- GCA and Friends of Shenandoah River partners for Goose Creek Watch monitoring project

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Goose Creek Watch

GCA and FOSR Partners for Goose Creek Watershed Chemical and Bacterial Water Quality Monitoring Program

- Launched Phase 1 - August 2021
- 6 sites monitored once a month
- Chemical & bacterial monitoring
  - Turbidity
  - pH
  - Dissolved Oxygen
  - Temperature
  - Conductivity
  - *E. coli* bacteria
  - Total Nitrogen
  - Nitrate/Nitrite
  - Total Phosphorus
  - Ortho Phosphate
  - Ammonia
- Water quality data is uploaded to Water Reporter
- Submitted to DEQ Annually

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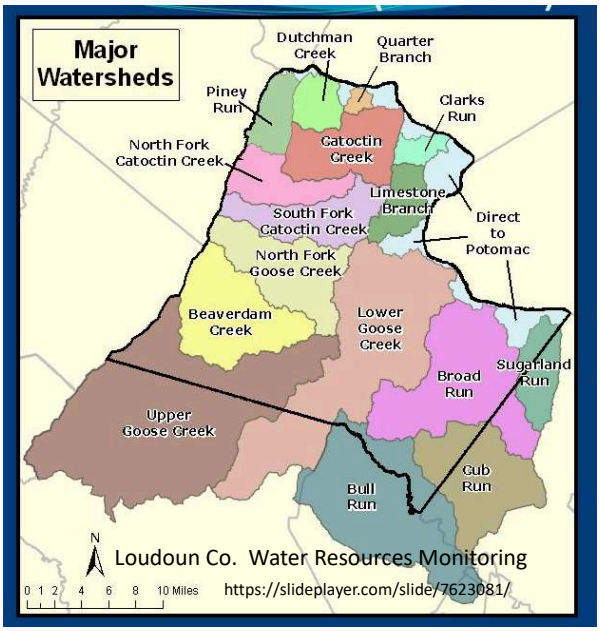
Goose Creek Watch Water Quality Monitoring

One of the first, and most important steps to understanding the threats to clean water is to monitor the stream water quality to identify trends before they even show an environmental impact.

- Fill data gaps
- Assess health of local streams
- Documents changes in stream health over time
- Prioritize sites for restoration efforts
- Document success and challenges of restoration efforts
- Discover and document acute pollution problems

19



Goose Creek Watershed & Water Quality Conditions

Sub-Watersheds

N. Fork Goose Ck
Beaverdam Ck
Upper Goose Ck
Lower Goose Ck

20

What Controls Water Quality in Streams?

- *Pollution Sources*
- *Point*: Municipal-Industrial Wastewater & Stormwater
- *Nonpoint*: Rural, forest, agriculture, urban land uses and runoff over watershed
- *Hydraulics*: Stream flow, velocity & reach length control pollutant levels by dilution of pollutant loads & travel time

Catchment altered by human activity

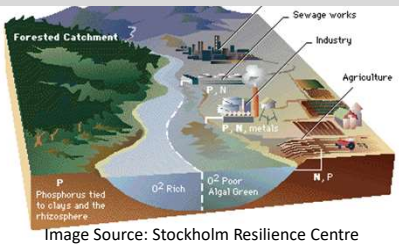


Image Source: Stockholm Resilience Centre

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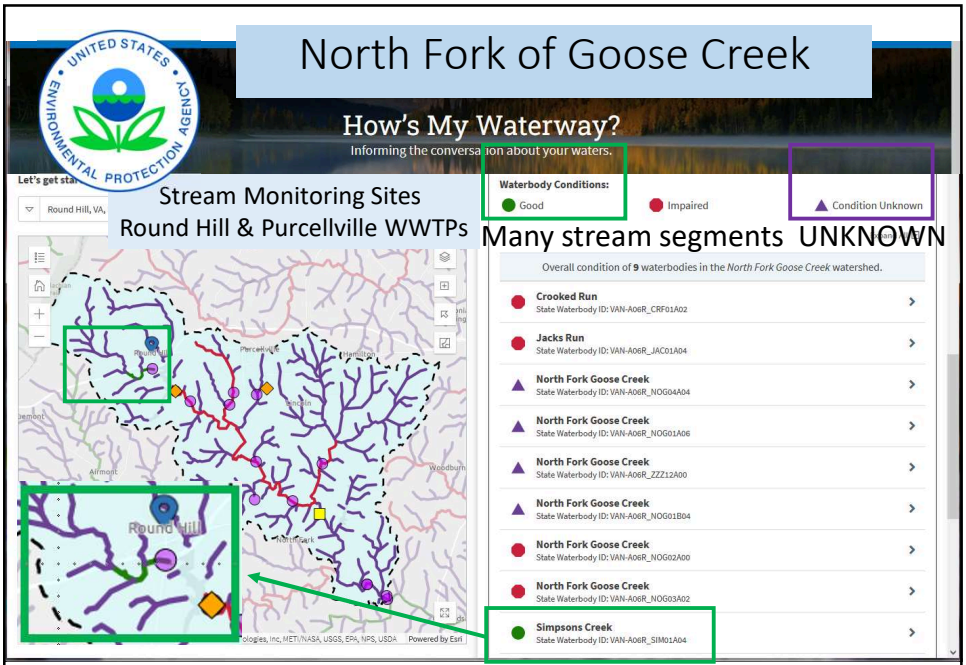
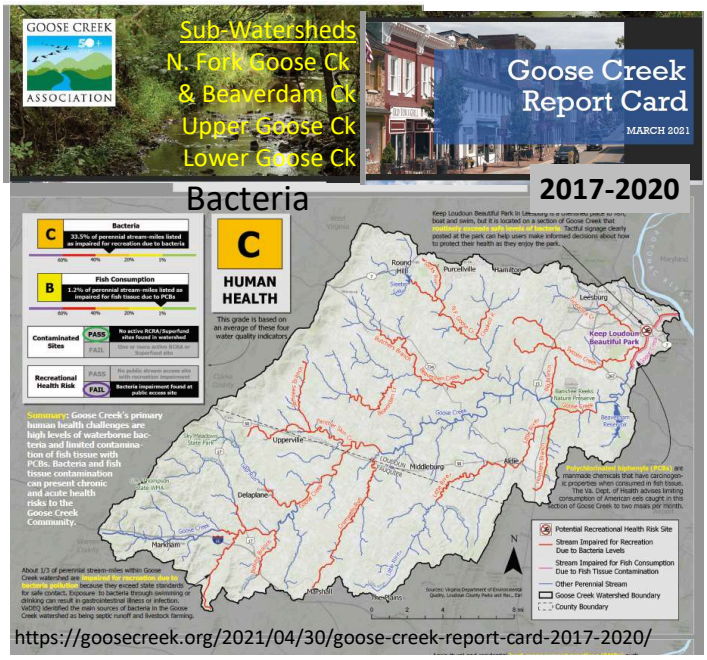
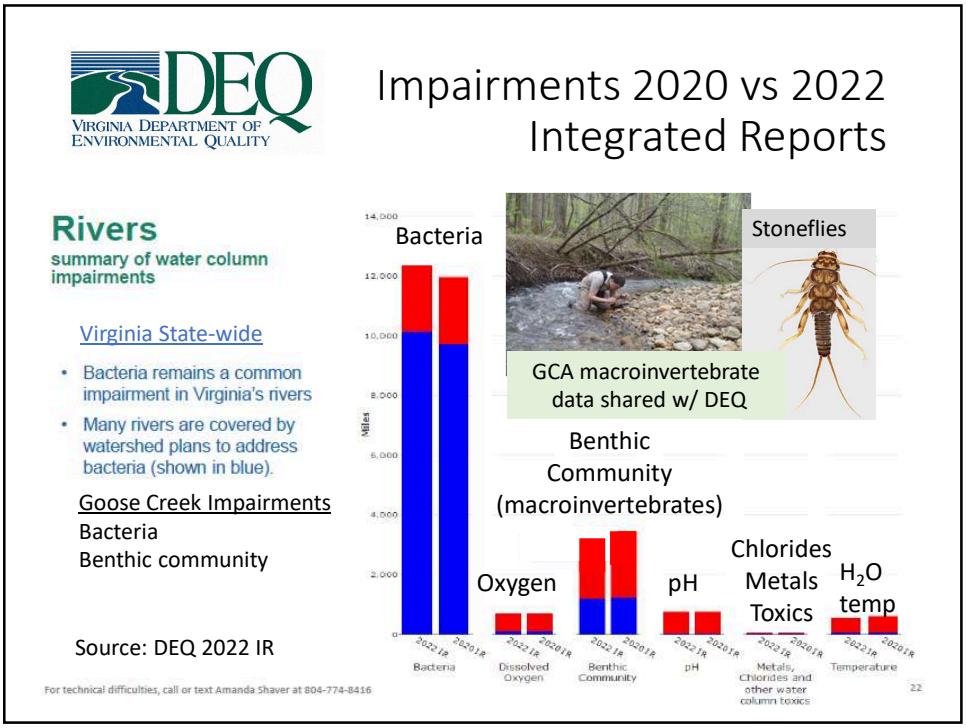
North Fork of Goose Creek



22


GOOSE CREEK ASSOCIATION
Sub-Watersheds
N. Fork Goose Ck
& Beaverdam Ck
Upper Goose Ck
Lower Goose Ck
Goose Creek Report Card
MARCH 2021
2017-2020
Bacteria
C
HUMAN HEALTH
Summary: Goose Creek's primary human health challenges are high levels of waterborne bacteria and limited contamination of fish tissue with PCBs. Bacteria and fish tissue contamination can present chronic and acute health risks to the Goose Creek Community.
https://goosecreek.org/2021/04/30/goose-creek-report-card-2017-2020/

23


DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
Impairments 2020 vs 2022 Integrated Reports
Rivers
summary of water column impairments
Virginia State-wide
Bacteria remains a common impairment in Virginia's rivers
Many rivers are covered by watershed plans to address bacteria (shown in blue).
Goose Creek Impairments
Bacteria
Benthic community
Source: DEQ 2022 IR
Bacteria
Stoneflies
GCA macroinvertebrate data shared w/ DEQ
Benthic Community (macroinvertebrates)
Oxygen
pH
Chlorides Metals Toxics
H2O temp
Miles
2022 IR
2020 IR
Bacteria
Dissolved Oxygen
Benthic Community
pH
Metals, Chlorides and other water column toxics
Temperature
For technical difficulties, call or text Amanda Shaver at 804-774-8416
22

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Causes of Impairments

- <u>High Bacteria Levels</u>
- Livestock with access to streams
- Failing septic systems
- Wildlife

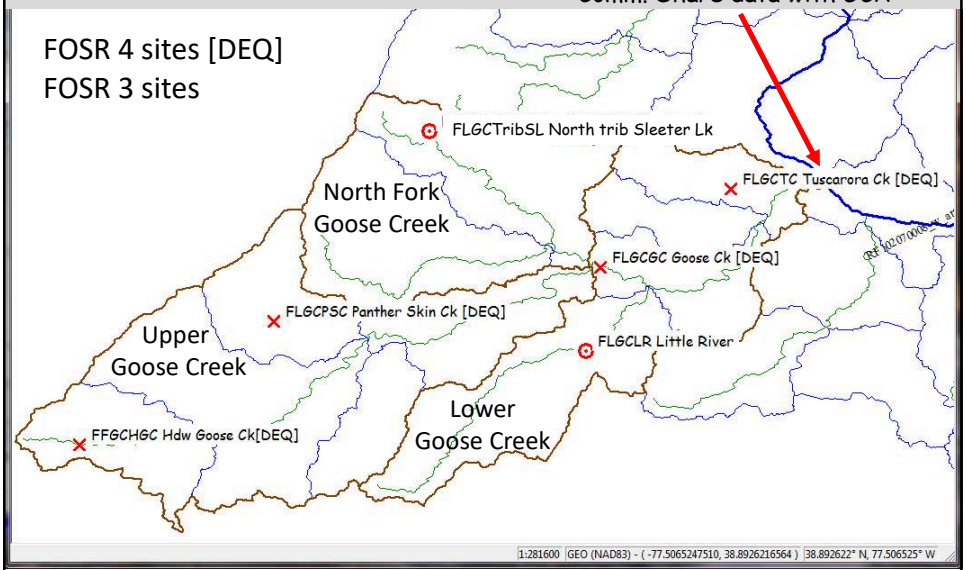
- <u>Benthic Community</u>
- Excess sediment degrades habitat for benthic organisms (macroinvertebrates)

- Runoff from agricultural land uses w/o adequate natural buffers along streams
- Livestock with access to streams
- Exposed & unstable stream banks
- Loss of natural riparian buffers from development

25

Where do we test?

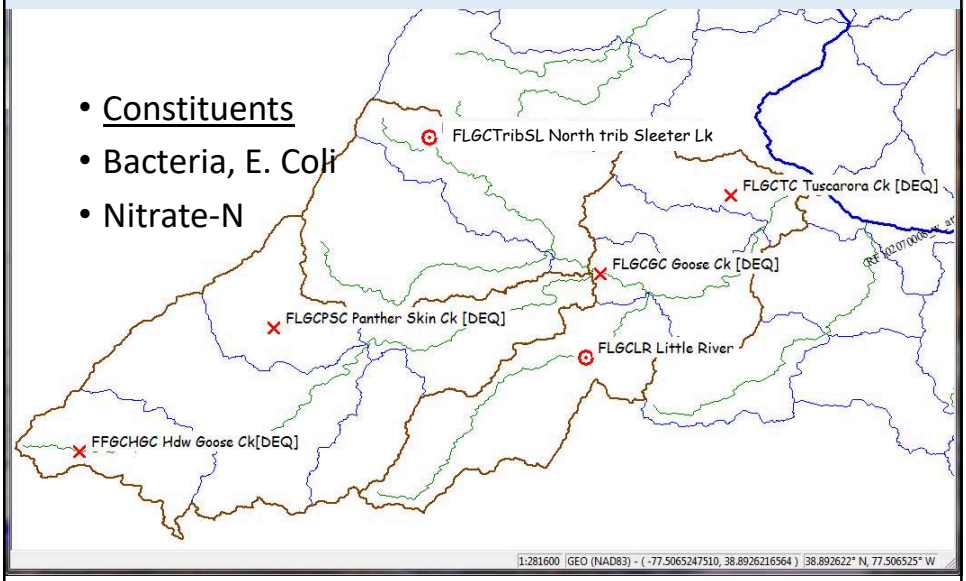
River Creek Confluence Park
Comm. Share data with GCA



26

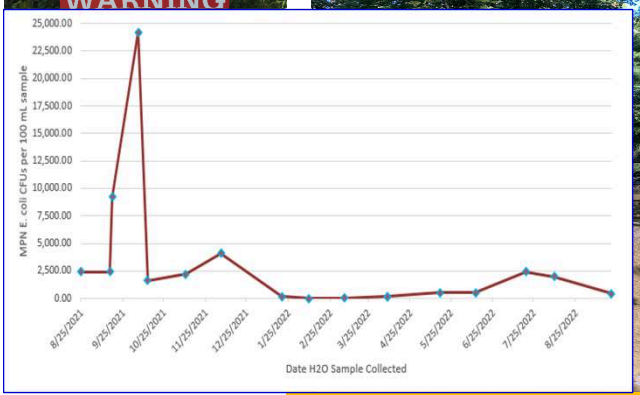
Year 1- Selected Results

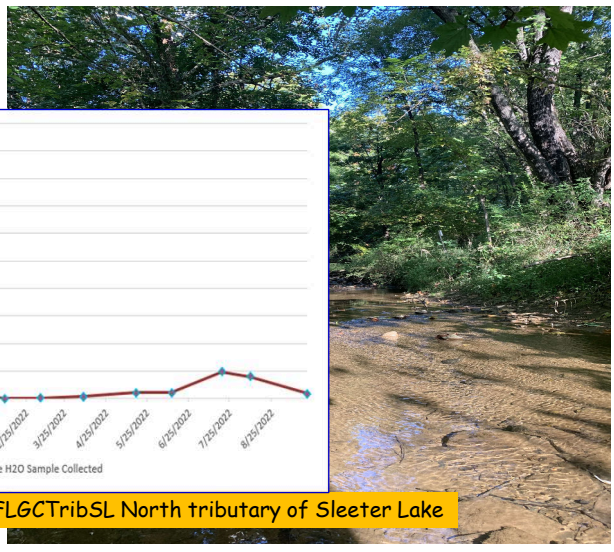
- Constituents
- Bacteria, E. Coli
- Nitrate-N



27

Year 1- Selected Results E. Coli

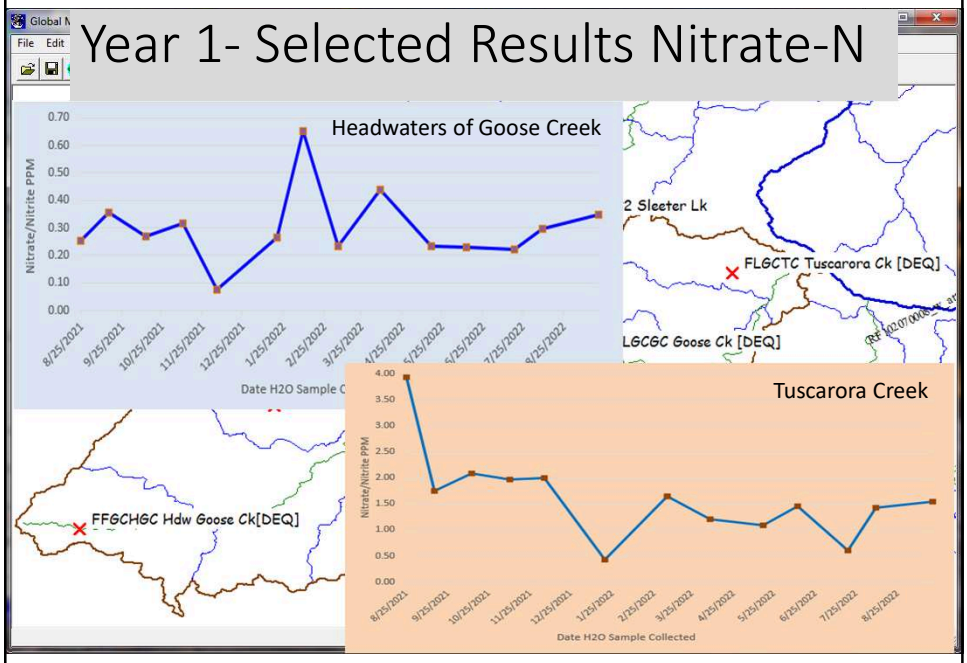




FLGCTribSL North tributary of Sleeter Lake

28

Year 1- Selected Results Nitrate-N



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Recommendations: Yr 2 & Beyond

- Collect samples for Bacterial Source Tracking (BST) in trib to Sleeter Lake
- New monitoring sites in Sleeter Lake to track bacteria levels
- New monitoring sites in headwater streams of Goose Creek watersheds
- New monitoring sites that match locations of existing USGS gages
- Why? Confirm Black Vulture roost is cause of high bacteria levels
- Why? Public health issue for exposure to pathogens from boating and fishing in new park
- Why? 65% of rivers are headwater streams & <u>not</u> monitored by DEQ
- Why? USGS streamflow & WQ data can be merged with FOSR WQ data

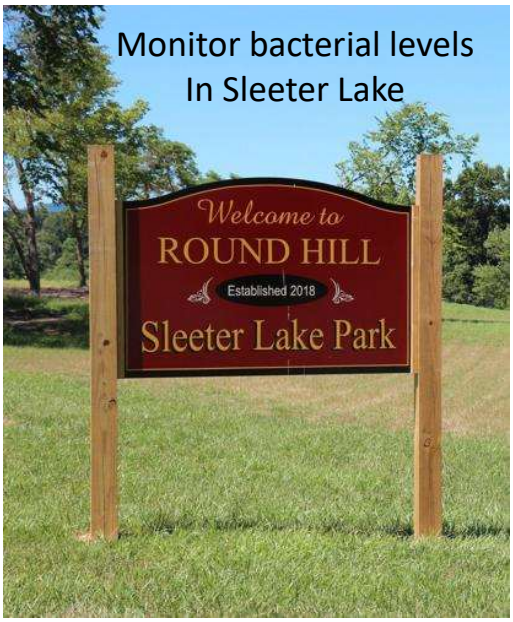
30

Bacterial Source Tracking

- Collect samples for Bacterial Source Tracking (BST) in un-named tributary to Sleeter Lake
- BST can discriminate between human & non-human sources of pollution
- BST used to identify individual animal/bird sp.
- BST used to identify unknown sample from DNA "fingerprint" of sp.

- Why? Confirm if very high bacterial counts are caused by Black Vulture roosting area in un-named tributary upstream of Sleeter Lake

31



- Why?
- New public recreation area opened in Aug-2018
- Potential public health issue for exposure to pathogens from boating and fishing

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Headwater Streams

- Identify additional monitoring sites to sample headwater streams of Goose Creek watersheds,
- Why? 65% of rivers are headwater streams and are <u>not</u> monitored by DEQ Water Quality network

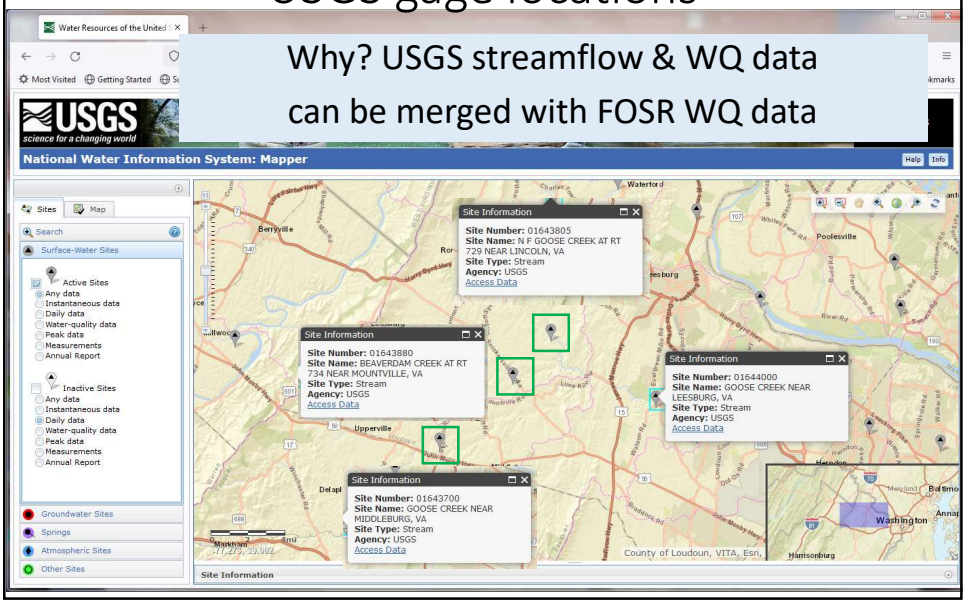
2022 IR - Assessment Overview

	Rivers (mi)	Lakes (acres)	Estuaries (sq mi)
Not Assessed (% total)	81,184 (80%) [1]	4,308 (4%)	393 (14%)
TOTAL	100,983	117,783	2,843

[1] Not assessed: approximately 65% of Virginia's rivers are headwater systems, and are not monitored by DEQ's ambient water quality network. These waters are routinely monitored via the Probabilistic Monitoring program and are included in watershed cleanup plans.

33

Select new sites to match existing USGS gage locations

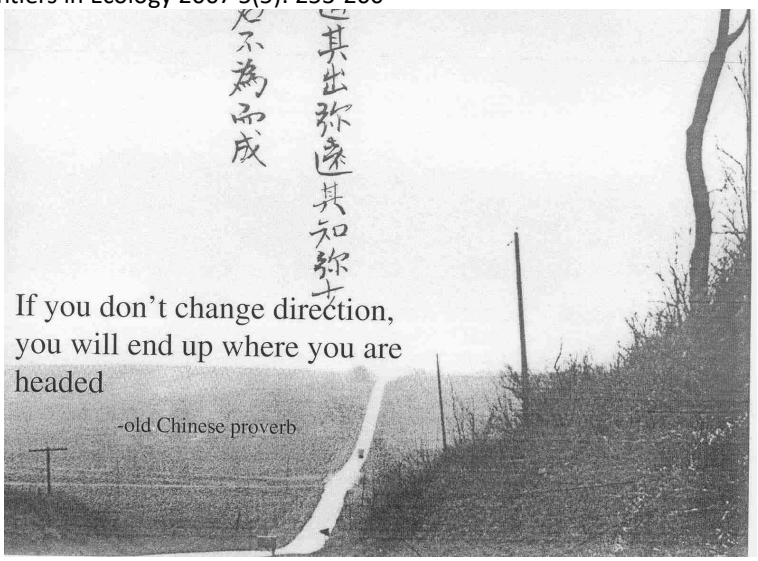


34

Who needs environmental monitoring?

Gary M Lovett[1*], Douglas A Burns[2], Charles T Driscoll[3], Jennifer C Jenkins[4], Myron J Mitchell[5], Lindsey Rustad[6], James B Shanley[7], Gene E Likens[1], and Richard Haeuber[8]

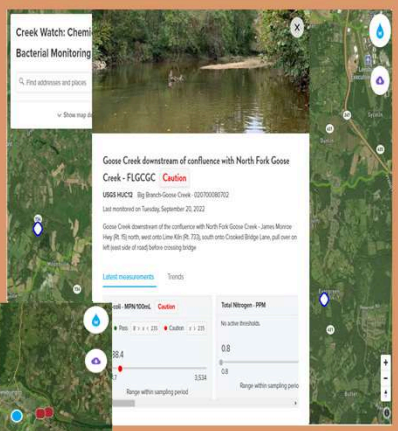
Frontiers in Ecology 2007 5(5): 253-260

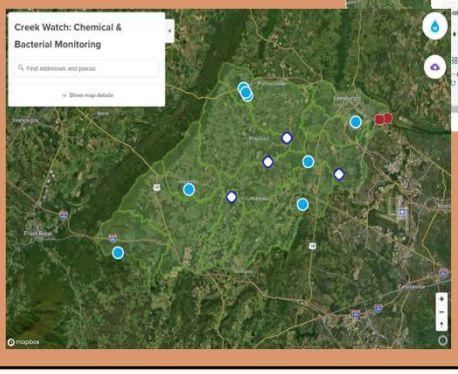


35

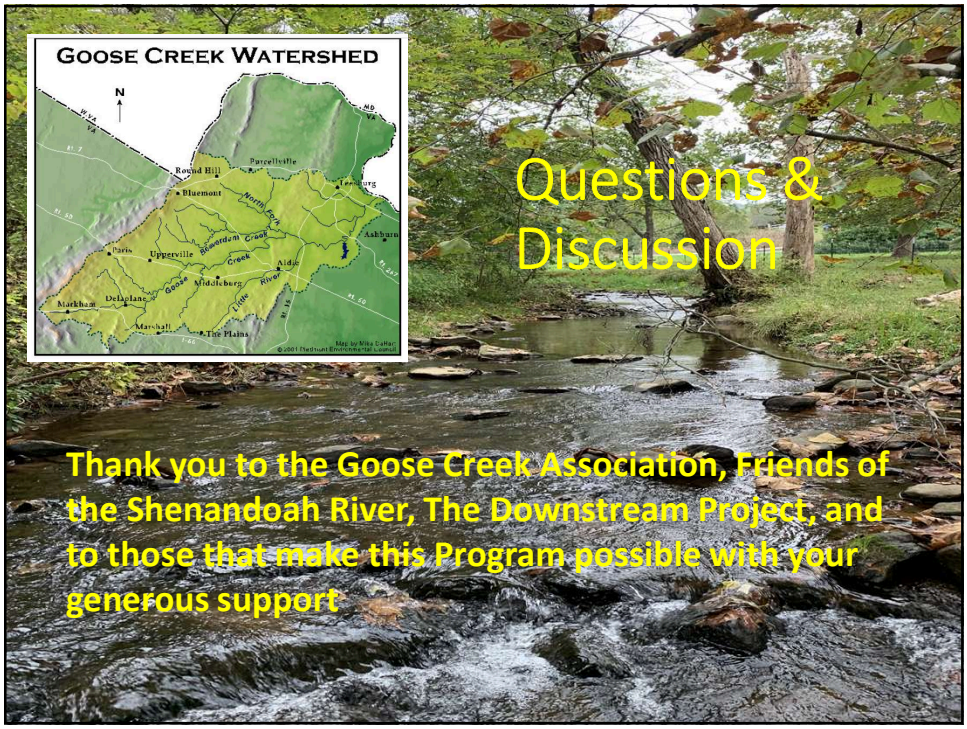
Water Reporter

Bill Howard, with The Downstream Project, will now show us the platform used to display data from the GCA and FOSR Goose Creek watershed chemical and bacterial water quality monitoring program.





36


GOOSE CREEK WATERSHED
N
Round Hill
Bluemont
Purcellville
Leesburg
Ashburn
Paris
Upperville
Aldie
Middleburg
Markham
Delaplane
Marshall
The Plains
Questions & Discussion
Thank you to the Goose Creek Association, Friends of the Shenandoah River, The Downstream Project, and to those that make this Program possible with your generous support

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