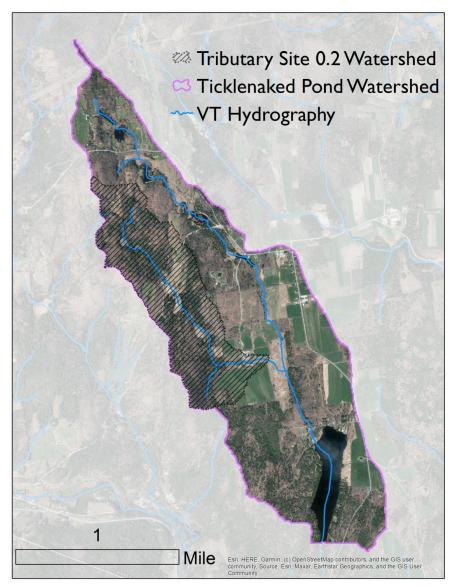


Monitoring Highlights



7 sites monitored in 2022

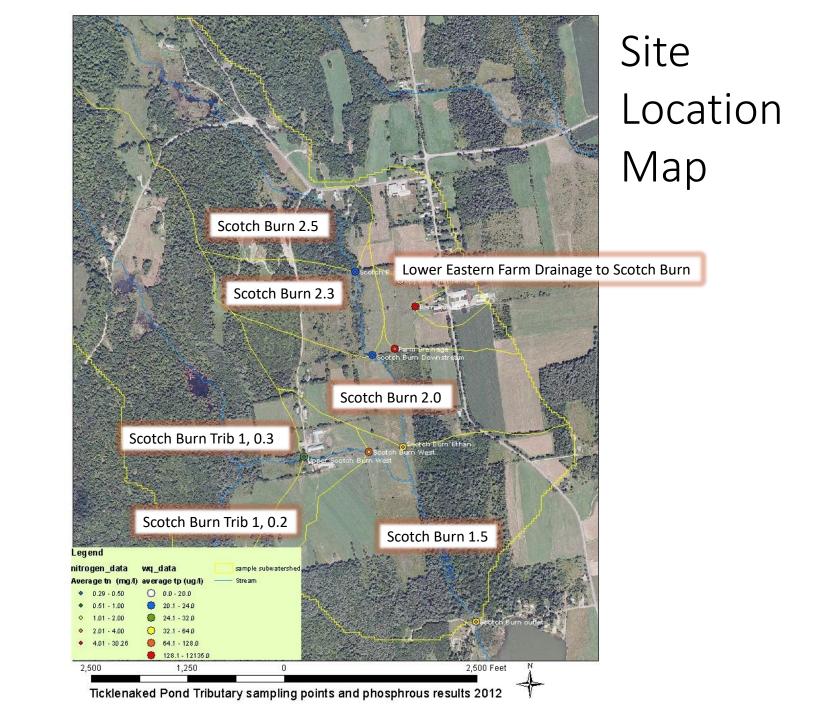
- Scotch Burn 2.5
- Lower Eastern Farm Drainage to Scotch Burn
- Scotch Burn 2.3
- Scotch Burn 2.0
- Scotch Burn Trib 1, 0.3
- Scotch Burn Trib 1, 0.2
- Scotch Burn 1.5

10 sampling events from April to September at same locations

We see improvements in the West Tributary from 2012-2021

East Farm Drainage watershed concentrations remain high







Scotch Burn 2.5



Scotch Burn 2.3



Scotch Burn 2.0



Scotch Burn 1.5

Site

Photos



Scotch Burn Trib 1, 0.3



Scotch Burn Trib 1, 0.2



Lower Eastern Farm Drainage to Scotch Burn

Chemical Parameters – Phosphorus & Nitrogen

Total Phosphorus

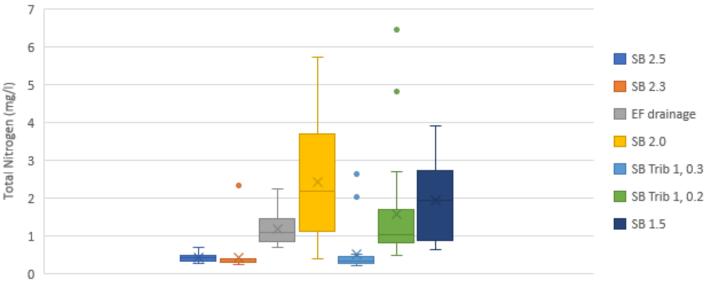
- Impacts
 - Fuels cyanobacteria blooms that can be toxic
 - Swimming use
- Sources
 - Developed land runoff, roads, driveways
 - Fertilizers lawn and agriculture
- Vermont Water Quality Standards
 - Ranges from 12-27 ug/L (ppb)
 - 12 ug/L for small high gradient streams
 - Based on baseflow conditions

Total Nitrogen

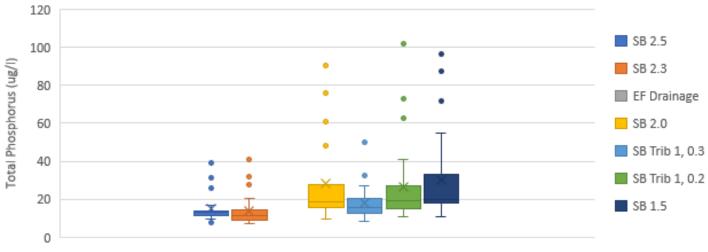
- Impacts
 - Can fuel specific types of cyanobacteria blooms
 - Too much nitrogen, as nitrate, in drinking water can be harmful to young infants or young livestock.
- Sources
 - Fertilizers lawn and ag
 - Sewage
- Vermont Water Quality Standards
 - Not to exceed 5.0 mg/l as nitrate, in Class B(1) and B(2) waters.
 - Not to exceed 2.0 mg/l as NO3-N at flows exceeding low median monthly flows, in Class A(1) and A(2) waters at or below 2,500 feet altitude, National Geodetic Vertical Datum.



Box Plot of total Nitrogen from 2012 - 2022



Box and Wisker Plot of phosphorus concentrations at all sites except Eastern Farm Drainage (off the chart with an average of 857 ug/l)



UPSTREAM

DOWNSTREAM

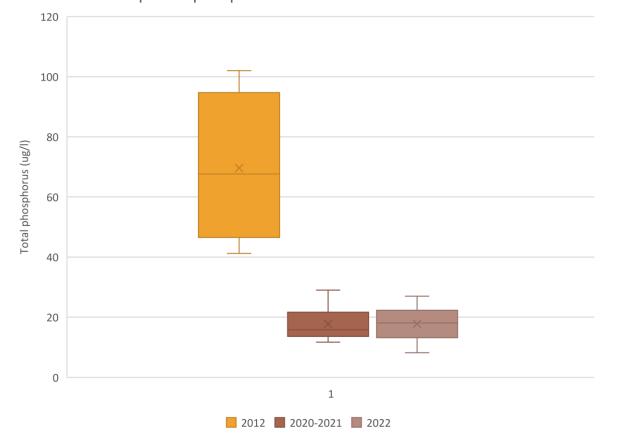
Scotch Burn Tributary WQ improvements after 2012.

There was a reduction in the average concentration at lower site from 70ug/l in 2012 to 18 ug/l in 2020/2021

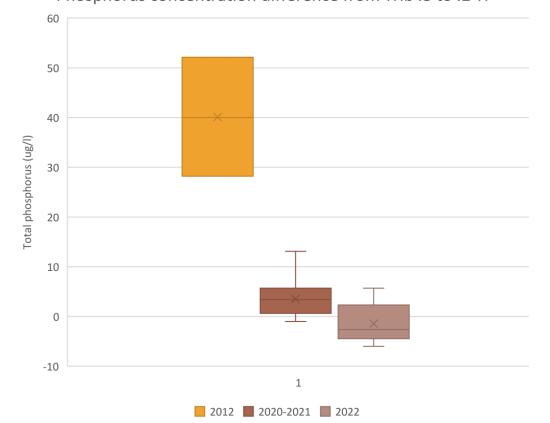


The improvement was evaluated by looking at the reduction in the increase from site 0.3 to 0.2, where this was reduced from an average 40ug/l increase in 2012 to an average 4ug/l increase in 2020 and 2021.





Phosphorus concentration difference from Trib .3 to .2 TP



Statistical analysis and Qualifiers (lots of them..)...

Qualifiers

1) Sampling design- In 2012, sampling only included 2 high flow events and 2 base flow events and only 3 dates at the upper site. Only 3 sample dates sampled in 2020.

Consistent sampling approach in 2021/2022 2 targeted flow events plus 8 base flow samples mean that more flow targeting was done in 2012.

- 2) Limited sampling data in 2012 which is our only "pre" data
- 3) A potential mix up between site 0.2 and 0.3 sample bottles in 2022 limits the use of this data for analysis

Results

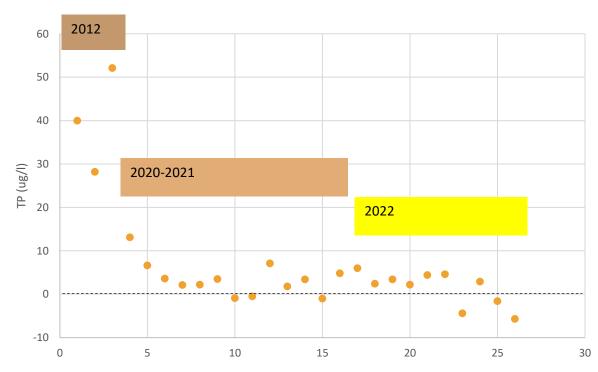
- Using a basic T Test this suggests that it is unlikely that this reduction is a statistical fluke (p value of .03) although using this approach is a stretch for reasons noted above and others...
- The magnitude of change was substantial and across both event and base flows.
- We only have two dates of nitrogen samples in 2012 but there isn't any evidence of a similar improvement in nitrogen.

Back of the envelope estimate of impact on Ticklenaked pond

In 2012 there was a 126% increase between site 0.3 and 0.2 which was reduced to 24% in 2020/2021.

This watershed at Site 0.2 represents 26% of the Ticklenaked pond watershed so this reduction could represent as much as 12% reduction in loading to Ticklenaked Pond (depending on loading rate of other tributaries) as an extremely rough estimate.

Change in phosphorus from Site 0.3 to 0.2 - 2012-2022



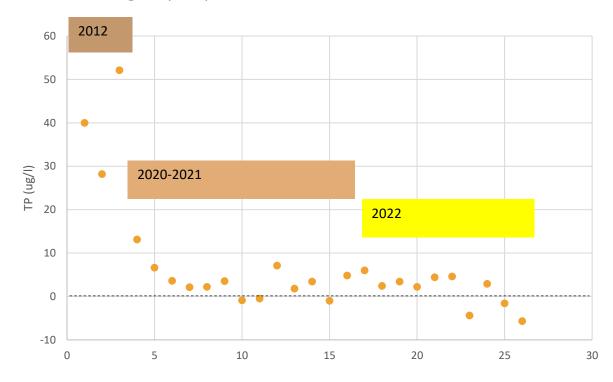
There are lots of assumptions necessary to evaluate reductions, but analysis suggests a significant reduction from 2012 to 2021.

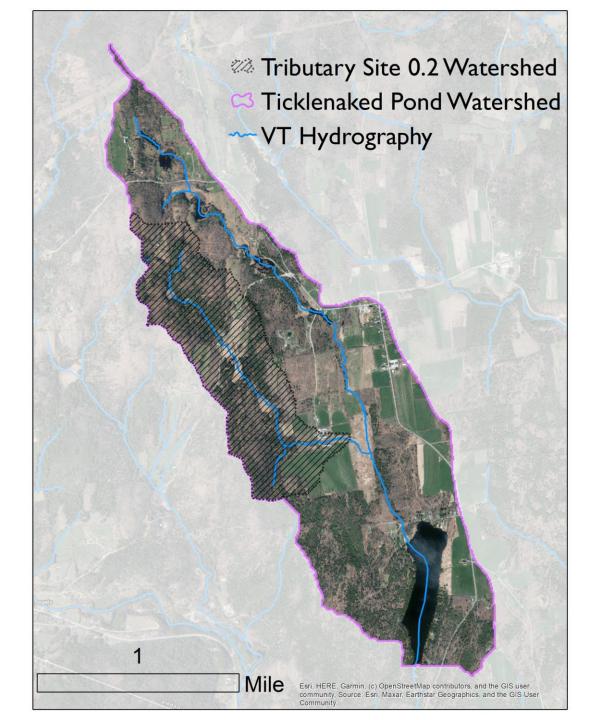
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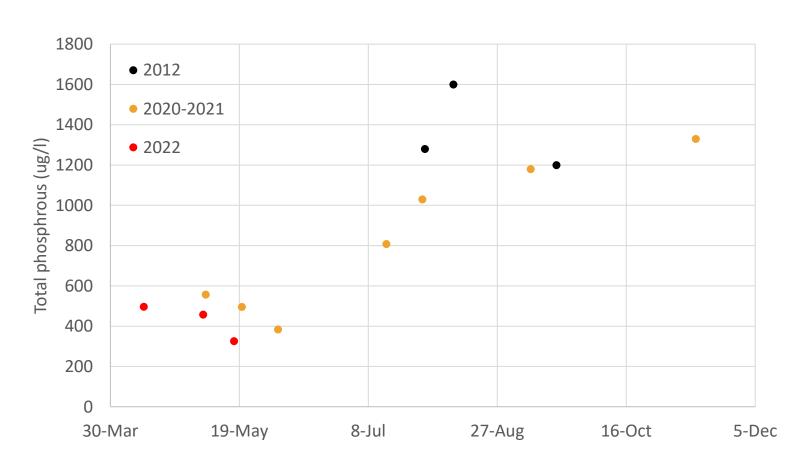
Change in phosphorus from Site 0.3 to 0.2 - 2012-2022





Farm Drainage

Eastern Farm Drainage Phosphorus over season

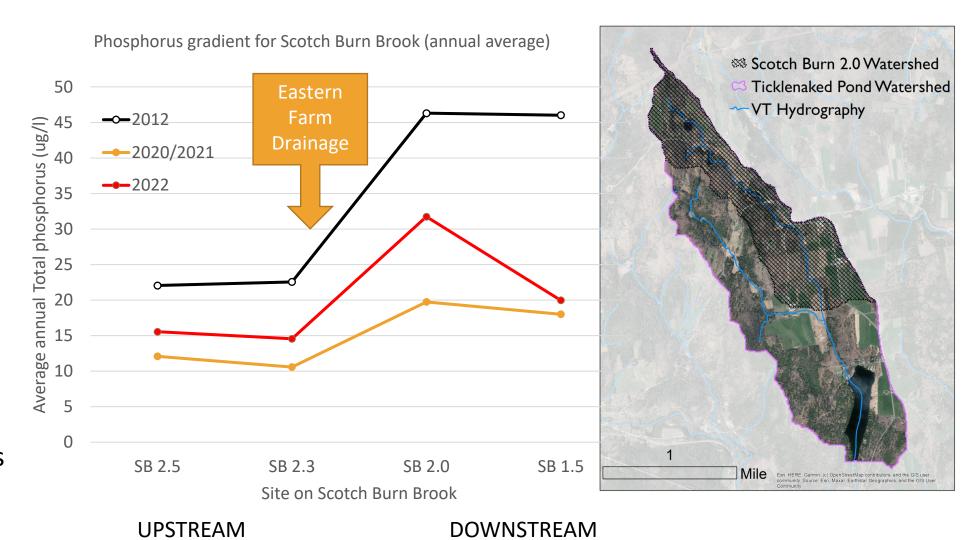




- Farm Drainage concentrations are very high on average (range from 300 to 1600 ug/l)
- Concentrations seem to trend higher later in the year which suggests more of a point source.
- There is no clear trend in the data in 2022 but this is limited as we only have spring runoff.

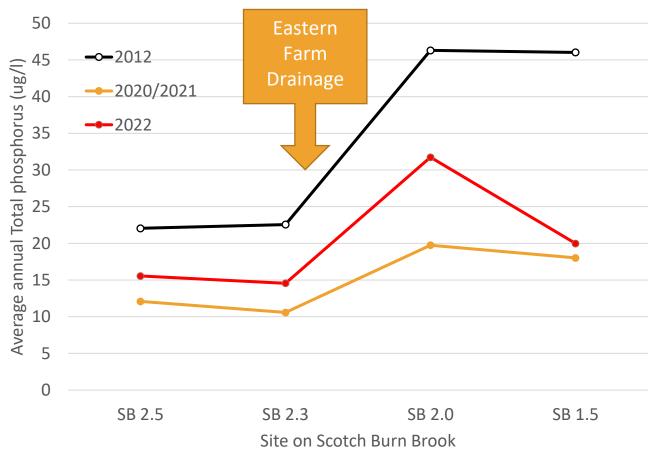
The gradient down Scotch Burn Tributary shows an increase from above to below Farm Drainage.

- Phosphorus concentrations double on average from site 2.3 to site 2.0 and this is consistent across all years
- The watershed of Scotch Burn Brook at this location is 39% of the Ticklenaked Pond watershed.
- This suggests that the Farm Drainage could contribute on the order of 20% of the phosphorus load to Ticklenaked pond (Lots of assumptions in this number!)

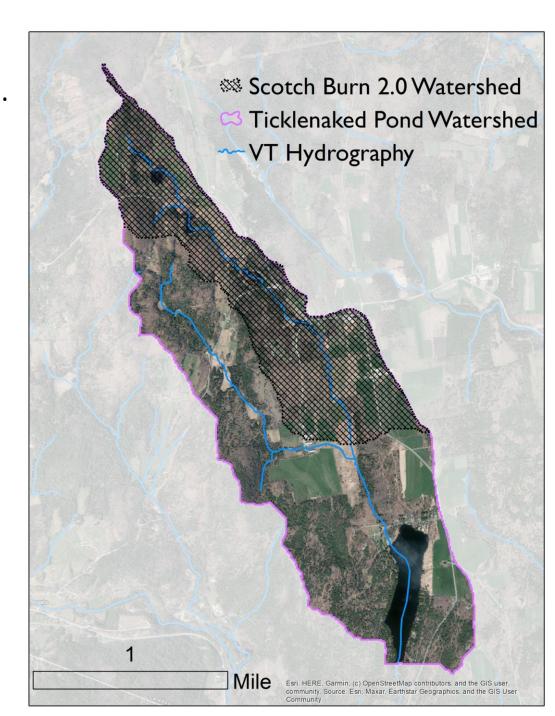


The gradient down Scotch Burn Tributary shows an increase from above to below Farm Drainage.



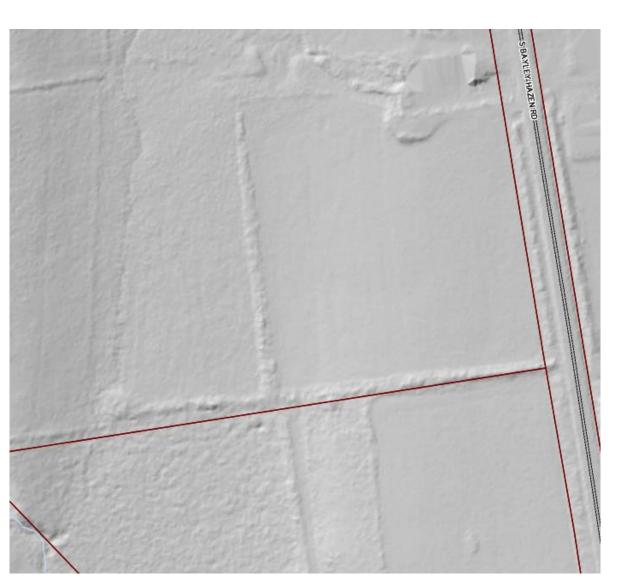


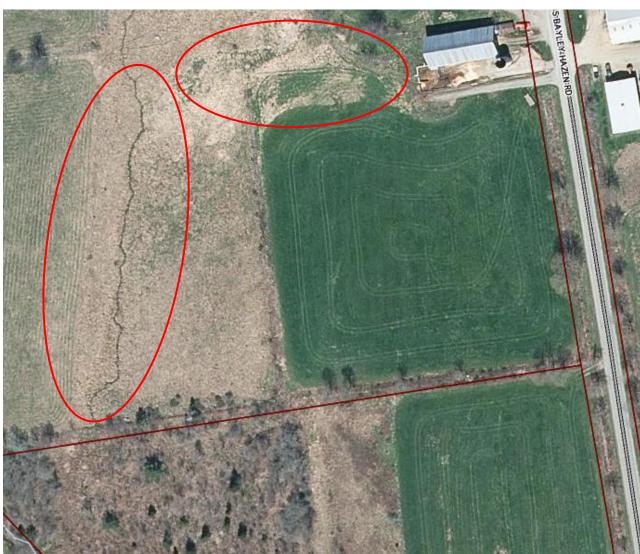
UPSTREAM DOWNSTREAM



Farm Drainage

Phosphorus may continue to be elevated in the farm drainage due to nutrient storage in the pond, wet pasture, and farm drainage or an unknown source but hopefully we will see reductions in 2023 sampling.





Recommendations for 2023 Ticklenaked Tributary Monitoring

- Will continue to monitor the same sites in 2023.
- Try to get 10 sampling events, including two flow events in 2023