To: Chesapeake Bay Management Board
From: Andy Miller, STAC Chair
Re: STAC COVID-19 Review + Workshop
Date: October 1, 2020

Background: A recent article notes that COVID-19 has both short-term impacts "dominated by direct effects arising from reduced human activity" and longer lasting impacts "likely to result from cascading effects of the economic recession on global poverty, green investment and human behaviour." (Diffenbaugh et al 2020). The article further notes that "[t]hese impacts offer the opportunity for **novel insight**" through "targeted data collection, coordinated model experiments and solution-oriented randomized controlled trials, during and after the pandemic."

While global impacts are a concern, COVID-19 has also affected the Chesapeake Bay and its watershed. STAC has started a review process to identify impacts, changing dynamics, and novel insights from COVID-19 and will use these findings to host a workshop(s) to inform current and future efforts to reach management targets for the Chesapeake Bay. This effort is focused on both short term and longer-term dynamics. For the short term (months), STAC is examining whether there is scientific data to gather now while the impacts of COVID-19 are currently being felt across the watershed and estuary. This may also affect management actions that can be taken now. For the longer-term (years), STAC seeks to better understand the impacts, changing dynamics, and novel insights that may come from COVID-19.

Potential steps to develop and refine the agenda in partnership across the CBP:
STAC is using an iterative process to collect and gather insights, then review and analyze them in conjunction with CBP staff. STAC held an initial brainstorming session on 9/15/20 and identified a number of topics for further investigation; these are summarized below in draft form. STAC is developing a short survey to send out to broadly to CBP and partners to explore the following questions:
- What risks, changes in system behavior, and learning opportunities associated with the consequences of COVID-19 do you see (short term, longer term)? In what ways? In what locations and/or scale?
- Is there anything novel or surprising to you that might help us understand something new about the system response?
- What would be useful for a deeper focus/STAC workshop to understand the scientific impacts and/or opportunities?

STAC is also researching how other regions have been impacted; examples include the Everglades, Tampa Bay, Puget Sound, Great Lakes, and the Baltic. In addition, STAC is hearing about potential research proposals and projects examining COVID-19 impacts. NASA recently announced funding for such research. Using what we find in this initial review, we are considering a workshop or series of micro-workshops (intensive discussions on specific topics) in Nov/Dec. to discuss findings and what action steps might be taken next.

STAC welcomes the Management Board's feedback on what might be most useful to survey and to explore more intensively. Here is what we want from you:

1. Please identify topics or trends that you believe are important and that we may have missed in our conversations thus far (see draft topics below).
2. Please identify the highest-priority ideas for STAC's focus.

References: Diffenbaugh, N.S., *et al.* The COVID-19 lockdowns: a window into the Earth System. *Nat Rev Earth Environ* **1**, 470–481 (2020). https://doi.org/10.1038/s43017-020-0079-1.

COVID-19 related impacts/changes already identified by STAC discussions (DRAFT)

Big picture dynamics (short term risks/impacts, changes, and learning opportunities for the Chesapeake Bay region; important to identify what and where (location, scale)? Longer term)?
- Less pollution in the short term, but harder to detect until longer-term (effects delayed?)
- Budget impacts: both shorter and longer term
- Definite short-term impacts, question is whether they have any potential long-term impacts. Examples include sustainable fisheries, water quality, public access, possibly land conservation?
- Positive -- less pollution due to less activity in the watershed causing pollutants in air from car traffic, stormwater runoff from construction which may be halted, etc.
- How long-lasting will the effects of COVID be on these goals in general? Will we be able to discern a signal amongst the long-term noise in the system?
- Impact of COVID-19 and environmental justice considerations: We know that COVID has exposed and exacerbated the gaps in health, economic well-being and opportunity that were already present. How can we best connect the DEIJ implications of COVID with the goals of the restoration effort?

Fisheries
- Changing fishing pressure (less commercial, more recreational→ overall decreased pressure on fish populations?)
- Need to change recreational fishing policies to accommodate increased pressure
- Interplay w/ crab/oyster fisheries

Ag impacts:
- Disruption to ag production: disruption in agricultural supply chain that resulted in destruction of crops/flocks/herds, milk dumping
- Acceleration of changes in livestock production patterns (e.g., failing dairies), already apparent, but now accelerated by COVID. How do these changes affect manure generation and application in agricultural watersheds?

Water quality/water supply/wastewater/in water work
- Changes to waste streams: wastewater treatment, stormwater, plastics, etc. (example: PPE showing up in stormwater treatment systems)
- Changes in patterns of water use/wastewater due to home based work/school; including possible shift from sanitary sewers at workplaces and schools to septic systems at homes outside of sanitary sewer service areas
- WQ. Opportunity for 'stress' test; does the system respond the way we think it should? Will novel circumstances lead to different outcomes than might have been predicted under more commonly anticipated circumstances?
- Interested in water quality impacts of changes in point source loads: changes? Effects?
- Are there changes in concentrations/loads from non-point sources that can be detected by comparison with other years of similar climatic patterns?
- Impacts to commercial shipping traffic on the Bay?
- Potential increased demand for navigational channel dredging

Changing traffic patterns and air quality questions:
- Decreases in driving; changes in traffic patterns/occupancy of commercial space
- Change in air pollution due to less traffic (less nitrate loading). Useful to do an in-depth look at reduced atmospheric deposition with attendant reductions to reduced N loads to the watershed and to the tidal Bay. Use the Bay Model System to examine.
- Zero bad air quality days this summer, in spite of heat emergencies
- Abrupt changes in atmospheric N and S deposition (fluxes, sources, isotopic composition, etc.)?

Recreational/open space/lawn care
- Increased visitation/use/impact of public/outdoor spaces for recreation, esp. in urban areas (Potomac, more)
- More pressure on natural areas; more people out boating/fishing/recreating
- More hammock use (tree damage)
- People swimming in polluted waterways due to closed pools
- Opportunity for outreach re: recreation
- Change in demographics of who is using parks, natural spaces
- More residential lawn care- more fertilizer/biocide applications (increased loading rates?) as people are home, using lawns more; more people gardening?
- When parks were closed, couldn't access boat ramps for recreation
- Need for public access to consider DEIJ issue
- Potential overuse of greenspace
- Opportunities to redefine stewardship as a more diffuse experience (don't need to gather in events); more exposure to parks by people who hadn't used them; redefining outdoor public spaces for dining/shopping and incorporating green infrastructure

Change in demographics/use patterns
- Change in demographics in who is using parks, open spaces? Do new crowds in parks represent the same demographics as pre-covid, or more or less diverse (potentially with long-lasting effects)?
- Suburban, rural development/housing boom

Educational:
- Experiences of young learners (Meaningful Watershed Educational Experience (MWEEs), env ed) due to disrupted school experiences
- Virtual learning is challenging just for the basics

Human resources/budgets:
- Loss of volunteers for NGOs
- Stewardship numbers definitely down without volunteer events
- Costly to redo project planning and surveys if too much time elapsed prior to construction (engineering plans, permits-- costs of engineering, legal teams for project planning)
- Changes to BMP construction and maintenance schedules due to COVID-19 impacts on personnel availability and budgets
- water quality project funding
- The financial hit is unknown but potentially large. In addition, immediate concerns may drown out long range but equally serious concerns like climate change.
- Tight budgets means less money for BMP installation, water quality monitoring, extras like voluntary projects
- All? Budgetary cuts and scaling back local implementation efforts
- Unpaid water bills and reduced consumer spending affected special purposes funds that support restoration work
- Reduction in staff to continue needed projects
- Fees collection

Data loss or opportunities, monitoring questions
- Changes to monitoring programs (cuts, increased costs due to COVID-compliance)
- Has data collection been impacted or are changes needed to better inform effects of covid?
- Loss of some monitoring data and increased monitoring expenses due to social-distancing protocols. Impact of such losses?
- Limited field work/data collection (work just starting in Oct. for fish surveys by NOAA)

- Loss of most monitoring of populations throughout the region (and beyond)
- Need to maintain our monitoring networks to capture these changes, yet those programs are being cut to save dollars
- Some field work has been lost, so we probably have less data to work with
- Opportunity for reviewing monitoring technologies and investing in new remote methods; plastics load due to shifting occupancy and activities
- Monitoring was non-existent for many municipalities due to reduction of staff during COVID policies - what was the duration of the gap across the different jurisdictions?
- Yes, track public use +/- and the impact on increased micro plastics, nutrient loads, etc
- Less field work, in general, particularly for basic science that may aid long-term understanding but is not clearly tied to current management objectives
- Links between specific commercial/economic activities and pollutants
- Capture the time series of change directly from discharges or emissions to get the best signal of change. Emissions of NOx and PS discharge change provide primary forcing but down steam monitoring effects in loads can also be examined.
- Wastewater volumes, lost field sampling, USGS gauges with real time NO3 might inform effects

Potential topics for a deeper dive? (ideas below developed in 9/15/2020 STAC brainstorming)
- What new monitoring technologies, if in place, could have provided key data during COVID?
- How have the fisheries impacts (commercial/recreation) played out?
- Generating better (more accurate) information on fine-scale fertilizer applications than is currently available (which is coarse).
- If nutrient dynamics are changing -- would be informative to see if N and P inputs are increasing and decreasing and from what sources -- esp. the non point source ones -- less N and P cause less activity or more N and P because BMPs are not being installed or maintained
- Load shifts that happened with no change in land cover (on which loads are based in the model); what other factors could be included in the model to enhance real predictability, e.g., occupancy, emissions, etc
- Need to understand how public-health effects and loss of employment and income as well as loss of tax revenues pass through the entire economic system and if those changes can be related to detectable changes in watershed or in Bay proper
- Contaminant input, fate and bio-effect
- Air quality
- Would data collection costs benefit from more reliance on sensor systems that require little human interaction
- Has COVID affected flow-normalized loads of nutrients and sediments and pollutants; all in the same direction or differently for each pollutant?
- Evaluating restoration priorities after COVID
- One topic we discussed previously was change in sanitary sewer loads vs septic as more people are at home
- Are there any DEIJ related to COVID COVID-19, DEIJ, and Bay Agreement: Certainly related to work force and employment issues and to considerations for future green workforce development, greater focus on environmental justice and who is exposed to risk and how. This is true across society, the question is which components of this are most relevant to Chesapeake Bay watershed and estuary and to the restoration effort
- Developing teams to go after funding now so that after we return to "normal" we can look at existing and on-going datasets that were collected throughout the pandemic. I.e. Before, During and After types of analyses (see NASA funding example).
- It would be good to look at a sensitivity analysis with the Airshed, Watershed and Bay CBP models. For example, what if the impacts of Covid19 nutrient reduction continued rather than being an episodic influence. A fine scale look at results would be interesting.

- Assume West Coast watersheds have competing concerns from smoke/fire this summer
- COVID is inherently a social event, so we need to involve a lot more social science than we usually do.
- Is it possible that by discovery of changes to loading during the pandemic we might be better equipped to identify the causative explanations (sources) of those shifts in loading, which may include changes in practices, behavior, attitudes, etc.?
- 2025 TMDL impacted by COVID 19?
- This is unique opportunity to test some of our assumptions on sources
- Covid event seems more useful to thinking about what is missing from our models